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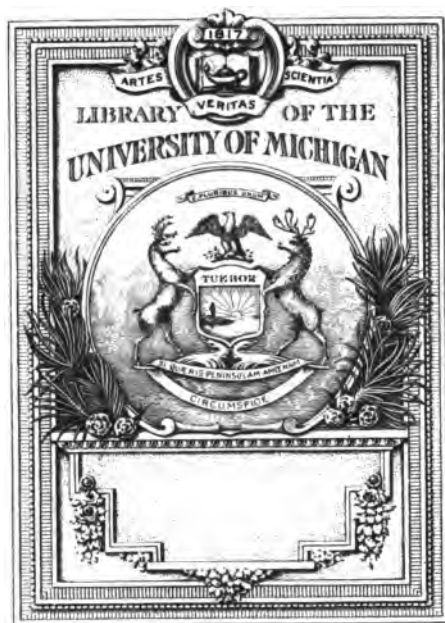
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*Vereinigung chemischer Fabriken Deutschlands.
Comité für die Weltausstellung in Chicago
1893.*

GUIDE

TROUGH THE

EXHIBITION OF THE GERMAN CHEMICAL INDUSTRY.

COLUMBIAN EXPOSITION

IN

CHICAGO 1893.



PRINTED BY JULIUS SITTENFELD, BERLIN.

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In the beginning of the year 1891, the industrial circles of Germany were officially invited to express their views on the question of contributing to the World's Exhibition in Chicago. The chemical industry was the first to hold out the prospect of a participation in the exhibition, at the same time taking up the position that a success for the industries of Germany was only to be hoped for, on condition of the Imperial Government supporting the undertaking with sufficient means. In October 1891, at a general meeting of the Association for the Protection of the Interests of the Chemical Industry of Germany, it was resolved to entrust the organisation of the Chemical Industry group in Chicago to a committee, composed of the chairmen of the eight sections of the trade-confederation under the presidency of the chairman of the Association and of the trade-confederation of chemical industry, Dr. J. F. Holtz. Accordingly the gentlemen whose names follow were elected members of the acting committee:

Director Dr. J. F. Holtz (Berlin), Chairman,
Dr. C. A. Martius (Berlin, Section I), Vice-chairman,
Director Storch (Breslau, Section II),
Ed. Zinkeisen (Hamburg, Section III),
Commerzienrath Dr. Grüneberg (Cologne, Section IV),
Dr. H. Gericke (Leipzig, Section V),
Eugen Haueisen (Ludwigshafen, Section VI),
Geh. Commerzienrath Ed. Oehler (Offenbach o./M.,
Section VII),
Johannes Zeltner (Nürnberg, Section VIII).

By subsequent co-optation the following gentlemen were added to the committee:

Director H. Büttinger (Elberfeld),
Commerzienrath Dr. Borsche (Leopoldshall),
Director Kuhlow (Halle o./S.),
Dr. Louis Merck (Darmstadt),
Director Dr. Richters (Breslau),
Director Stroof (Griesheim),
Geh. Commerzienrath G. Siegle (Stuttgart),
Dr. F. Witte (Rostock).

The secretaryship was confided to Dr. M. Wiedemann (Berlin).

The committee undertook the task of effectually representing the interests of exhibitors, and of adopting all such measures as should be found necessary to bring about a collective, self-contained exhibition of the chemical products of Germany at Chicago.

In a number of sittings the committee laid down the guiding principles for the co-ordination of the chemical industry group. It was resolved to adopt uniform regulations, not only for the fitting up of the exhibiting space, for the show-cases and the pavillions, but also for the collective expedition of the goods of the whole body of exhibitors.

The plans of the show-cases, the pavillions and the decorative parts were supplied by the architect Herr Hans Grisebach (Berlin); the execution of the work was entrusted to Ferd. Vogts & Co., court artistic cabinet-makers (Berlin). The forwarding of the parts of the show-cases and of the exhibits took place via Hamburg through Kampe & Co., forwarding agents, Hamburg.

The representation of the group was entrusted to Herr Fischer (Berlin), who, during the period of the exhibition, will afford to visitors every information respecting the firms belonging to our group, and may always be seen at our pavillion during business hours.

The following „Guide through the Exhibition of the German Chemical Industry“, compiled, at the request of the Committee, by a distinguished German scientist, will be placed for

distribution in the hands of exhibitors in our exhibition building. In addition to the notices on exhibiting firms, it contains introductory articles on the individual groups of the chemical industry represented at the exhibition, and is calculated to afford the visitor not only a general view of the objects exhibited, but an insight also into the development and the capabilities of the chemical industries of Germany.

THE COMMITTEE

of the

**Association of the chemical factories of Germany for the
World's Exhibition at Chicago 1893.**

Dr. J. F. Holtz,
Chairman.

Dr. C. A. Martius,
Vice-chairman.

Henry T. Böttlinger. Dr. Borsche. Dr. J. H. Gericke.

Dr. H. Grüneberg. Eugen Haueisen. Julius Kuhlrow.

Dr. Louis Merck. Eduard Oehler. Dr. Richters.

G. Siegle. Storch. J. Stroof. Dr. F. Witte.

Johannes Zeltner. Ed. Zinkeisen.



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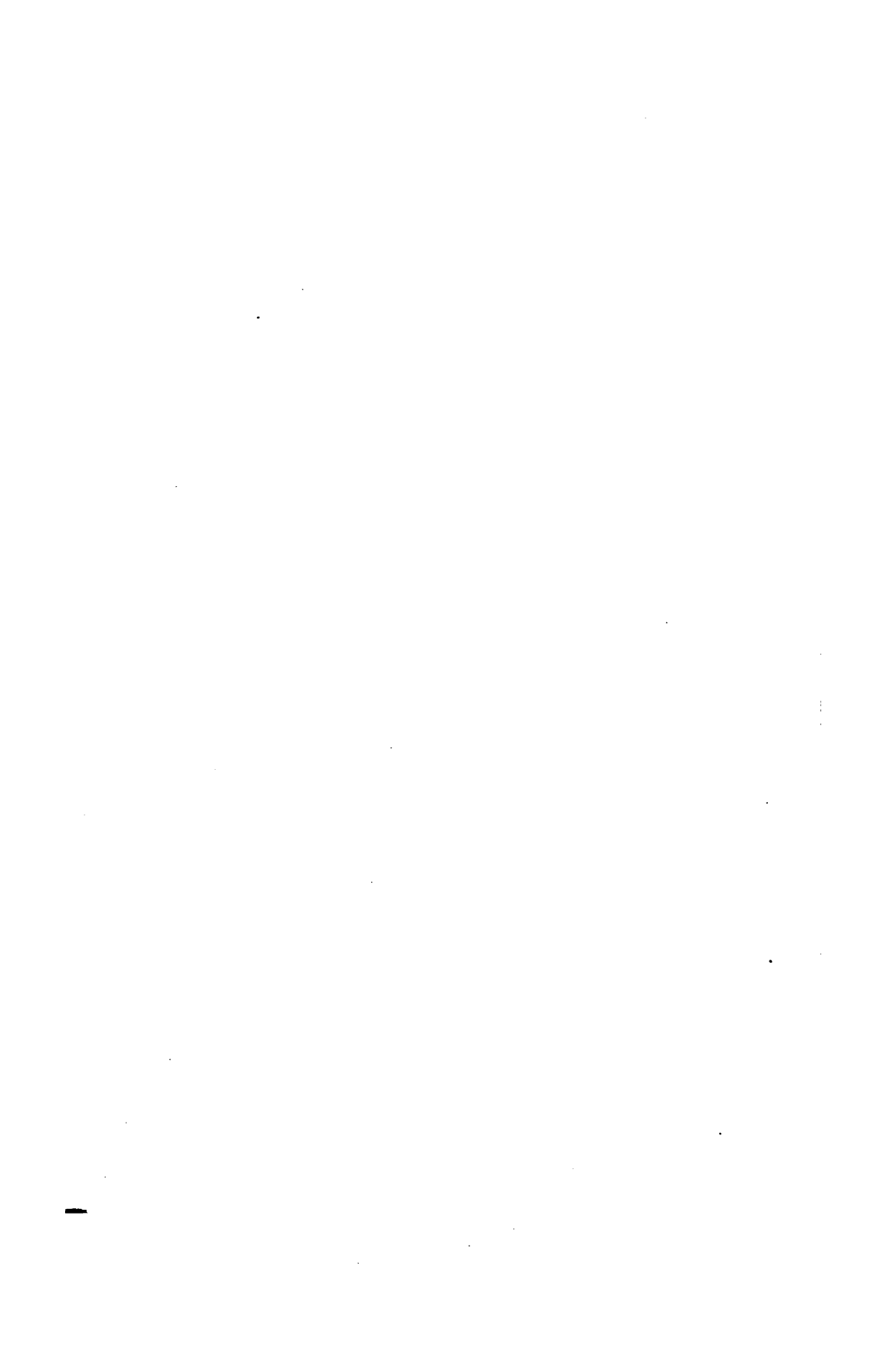


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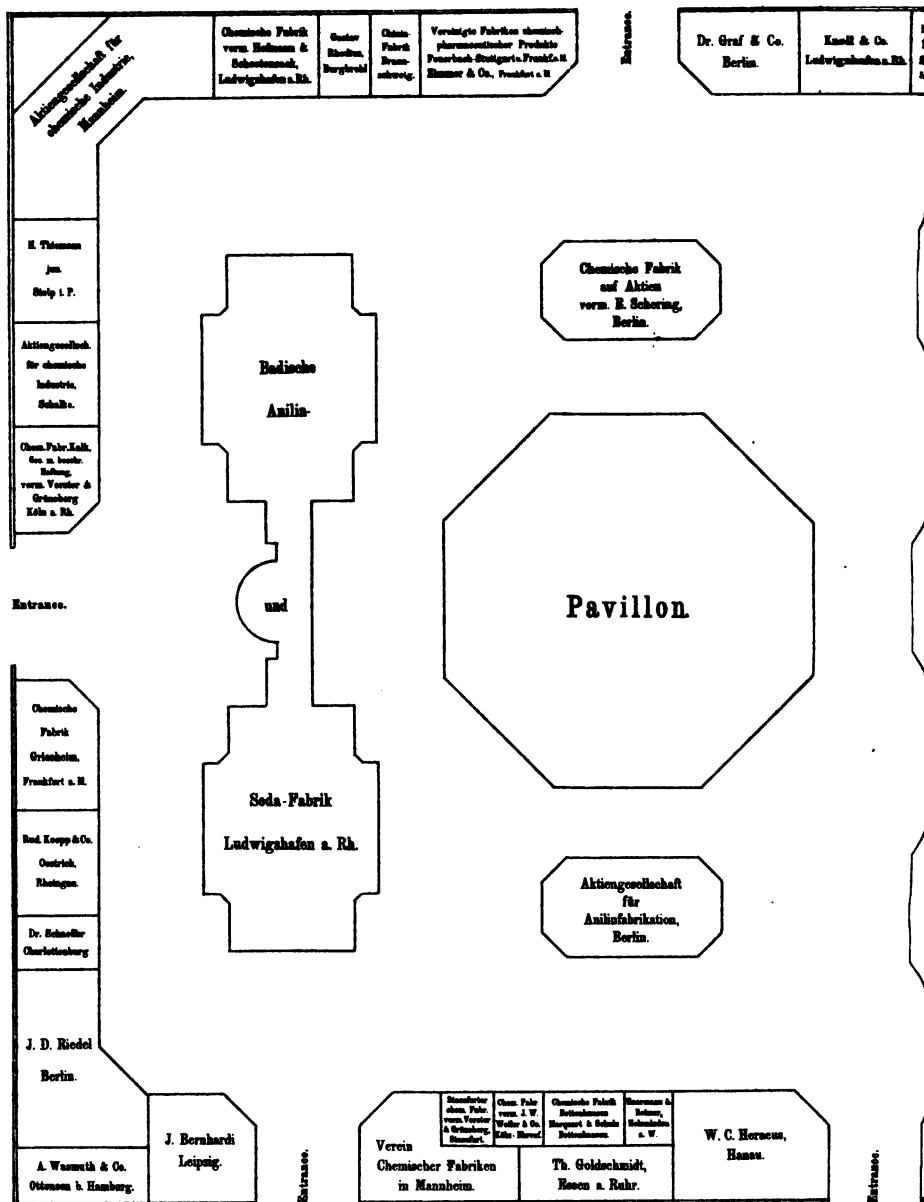




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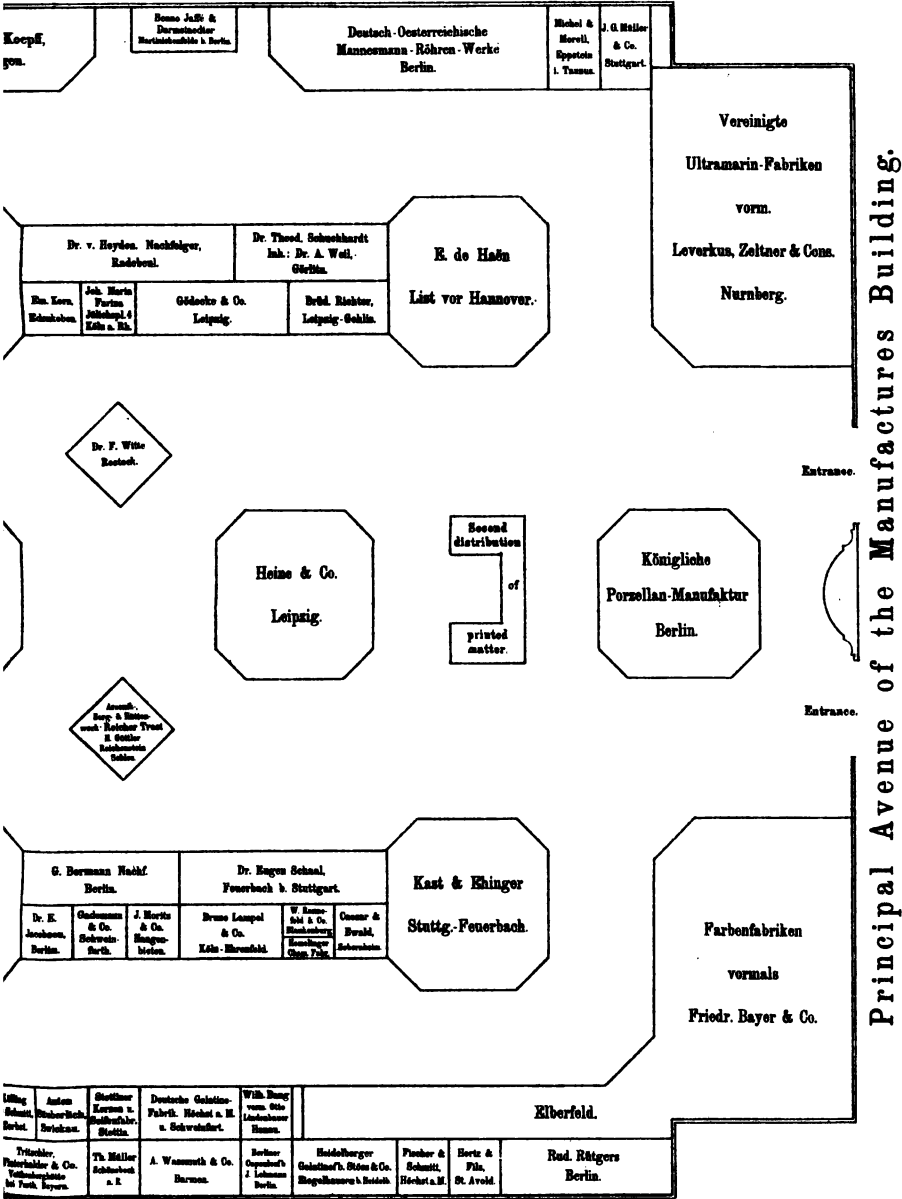


Plan of the German Chemical Collective Chicago



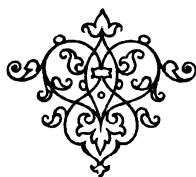
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an Section.





Exhibition

of the

German chemical industry.



he German chemical industry, the extraordinary capabilities of which, not less than the multiplicity of its productions, is universally acknowledged, is almost wholly the creation of the last hundred years. Admitting that many of its higher branches of manufacture were originally imported from other civilized countries, still they have maintained and developed themselves on German soil in their own peculiar and independent fashion, and mingling with the industries of native creation, have grown into a grand and self-contained whole. In no other country on earth does there exist a chemical industry, which comprehends, equally with the German, all branches of chemical manufacture. The grounds for this evolution, so varied and so fruitful in every direction, are manifold, and it may well be maintained that, without the concurrence of favourable circumstances, such as those which have arisen in quite a special manner in Germany, a development so rapid and on so grand a scale would have been quite impossible.

The foundations of the chemical industry are mining and agriculture. Only in a land where these occupations have attained a certain expansion and completeness, is it possible

for those arts to develop, whose task it is to transform the materials supplied by nature. This fundamental condition obtains in the German empire. The existence of an ancient mining and metallurgical industry, highly developed, and, owing to the multiplicity of the occurring minerals, highly diversified, became the starting point of a chemical trade, which leaning at first on those processes indispensable to the miner, which, are connected with the dressing of ores, very soon attained complete independence. In the same way, the endeavour to increase, by technical transformation, the value of the raw products of agriculture gave rise to an agricultural chemical industry. To both these industries, raised on native foundations, there was very soon added a third, that which selected for its starting point the raw products from foreign lands supplied by the highly developed commerce of Germany. As these spheres of production steadily expanded and came into contact on many points, they soon became dependent upon each other for support, and ultimately coalesced into the solid and compact *ensemble*, which is presented by the modern chemical industry of Germany.

Another circumstance must here be mentioned which contributed to the rapid development of a chemical industry in Germany, namely the peculiar and independent position which pharmacy has attained in our country. In contradistinction to many other lands, where the preparation of remedies constituted a secondary occupation of medical men, here in Germany a close and highly educated order of apothecaries came early into being, which devoted itself with especial zeal to the study, not only of pharmacology, but of the natural sciences generally. Many of these apothecaries carried on the culture of medicinal plants on an extensive scale, as well as the preparation of extracts and other medicines in the laboratories connected with their businesses. These workshops, in many cases, have in the course of time, grown into vast factories, some of which still devote themselves mainly to the production of medicines, whereas the greater number have turned their attention to other specialties of the chemical trade. Moreover, from out of the profession of apothecary, numberless

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recruits, well trained in chemical manipulation, and familiar with the neat and methodical work of the laboratory, have passed over to scientific chemical research and to chemical industry, and the tide has not yet ceased to flow up to the present day.

Notwithstanding the cooperation of so many factors to produce what we compendiously call the German chemical industry, the evolution of the latter was neither rapid nor effected without trouble, and it has been rather a blessing to our industry that none of its departments have attained finality, shutting themselves up in a hard-and-fast, narrow routine of working methods. Each in the instinctive struggle for an expansion of its sphere of activity, has lived in a state of perpetual transformation, which made it impossible for the manufacturer to come to a standstill, and, after the fashion of the handicraftsman, to reap the fruit of acquired knowledge and skill. Whenever a branch of the chemical trade was on the point of indulging in any such state of inertia, it was fatally carried forward by the constant changes operating upon the other branches, with which it stood in intimate connection.

In this restless struggle for progress, which inspired the whole and irresistibly hurried along the units, and the not inconsiderable perils of which only became manifest after they had been overcome, the chemical industry of Germany possessed a trustworthy and never-failing helpmeet in chemical research, which simultaneously had attained the highest position of excellence. Such is the intimacy, in the German empire, between chemical research and chemical manufacture, that the periods of most rapid development of the one, have always been epochs of prosperity with the other. The pioneer labours of a Liebig, in the forties, were the signal for the creation of new branches of chemical industry, which rendered invaluable service to agriculture, just then placed upon a scientific basis by that great investigator. The splendid discoveries of A. W. Hofmann in connection with the aromatic compounds bore fruit in the manufacture of artificial colouring-matters, in which the German chemical industry has achieved its greatest and most brilliant triumph. Nay more, the development of chemical theories, so entirely unconnected at first sight with industry,

has been turned to account by manufacturing chemistry; we behold with astonishment the further evolution of the colour-industry in closest connection with the expansion of the benzene-theory; the study of the phenomena of solution becoming the starting point of the newly-founded potash-industry, and starting from the abstract regions of thermodynamics and the kinetic theory of gases, a complete revolution in the methods of heating.

The activity of scientific chemical research is not limited to the constant enlargement of the field, on which industry can use its lever with a view to fresh conquests, but it also contributes unceasingly to the completion of already existing departments by the introduction of new processes for the attainment of valuable products, and by the discovery of more refined methods of analysis, by which means alone a steady control and improvement are rendered possible. In that connection, industry will ever be mindful of the services of a Wöhler, a Bunsen, a Fresenius.

German chemical industry, which has ever acknowledged scientific research as its basis and the very breath of its life, has not been slow, with its own peculiar means of action, to contribute to the advancement of research. On parallel lines with the State research-laboratories, in the erection of which, at the instigation of Liebig, Germany has played the part of a pioneer, it is a pleasure to note the creation of similar establishments in connection with chemical works, and that, accordingly as the former developed, the latter assumed ever increasing proportions. Many an important investigation, from the standpoint of pure science, has emanated from the workshops of chemical industry, and more numerous still are the fundamental researches, executed in the State laboratories, which owe their inception, as well as the necessary materials for carrying them out, to manufacturing chemistry. But the most remarkable and the most important result of this intimate, and for both parties, salutary co-operation of science and technique, lies in the fact that German industry, mindful of its continuous striving for further development, has disdained at all times to educate its

auxiliaries by the means ordinarily adopted in handicrafts. The practice, known in other branches of manufacture, of taking apprentices, has never obtained, even experimentally, in German chemical factories. On the contrary, the kind of preparatory training, required for admission into a chemical factory, has always been exclusively that of the scientific investigator. Manufacturers only require of their assistants a thorough scientific education, taking upon themselves their initiation into the technicalities of their special branch of business, a task rendered at all times the easier by the fact, that from the very first day the young chemist finds occupation, and the means of gradually becoming acquainted with his duties, in the laboratory never found wanting in a chemical factory. If confronted in his future career with new problems, he falls back for their solution upon those methods of strict scientific investigation, so familiar to him in his student's days. Not by desultory groping, but by judiciously arranged series of experiments, he seeks for, and finds, the solution of the difficulty.

It may be asserted that, not only is the strength and productive power of German chemical industry based upon the intimate connection between science and practice above described, but that in that intimacy lies the surest safeguard that German industry will long continue to hold the prominent position which, with such strenuous exertion, it has ultimately achieved. When the question is asked, why the chemical industry of other lands, still more favoured perhaps by nature, has, in the end, been surpassed by the German, the answer is that Germany has had the good fortune to call her own a number of the greatest intellects in the domain of pure scientific research, who have quickened the pace of theoretical chemistry. But, as before stated, it is the latter which constitutes the vital element of chemical manufacture. Only the land, which, some day, will assume the leadership in pure scientific chemical investigation, will also be in a position to snatch from German chemical industry the palm to which it is at present entitled.

This is the place to point out that at the period of economical expansion, which followed upon the reestablishment of

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the German Empire, chemical industry did not go empty-handed, nor was it overlooked at the subsequent settlement of the legislative foundations of the new state. True, it derived no immediate advantage from the protective policy of Prince Bismarck, for whereas it was strong enough to dispense with protection, its products were in many countries loaded with retaliatory duties. On the other hand, in consequence of the unitary character of the imperial legislation, arrangements were introduced which proved to a large extent beneficial, though the period of transition thus brought about was by no means an easy one.

In the first line must be mentioned the German patent law, the introduction of which dates from the year 1877. This, as is well known, is based on the principle, also recognized in the United States, of a preliminary examination of every invention for which a patent is demanded, a principle which from the theoretical standpoint, must be acknowledged to be the correct one. Its practical application, however, involves grave difficulties, which, indeed, have made themselves felt in no department more acutely than in that of chemical invention. Attempts have been made to overcome these evils, partly by suitable enlargements of the law, partly by corresponding practical regulations; it must however be admitted that the German patent law is still at the present time in a state of transition. Its creation, nevertheless, has borne rich fruits in the domain of chemical manufacture. In the first place, it must be acknowledged that the patent law, which limits the rights of the inventor, and at the same time expressly protects them, has rendered unnecessary the game of hide-and-seek formerly so common in chemical factories, and has put a stop to the demoralisation of employes which was the inevitable consequence. Then again, in the large number of patents which from time to time have been granted, a rich store of chemical knowledge has accumulated for the benefit of science, as well as of manufacture, inasmuch as it has acted as a stimulus to further effort. Lastly it is owing to the patent law that an intercourse, based on legal safeguards, has sprung up between industry and such discoverers as work outside its

limits, giving the former the benefit of forces which, under less favourable circumstances, would not have been available.

Another new and, for chemical industry, pregnant creation of the Empire, is the now well-nigh completed social-political legislation, which, while improving the relations between manufacturers and the workpeople employed by them, has at the same time imposed heavy burdens upon industry.

Adaptation to the obligatory insurance against sickness was doubtless less difficult for the chemical, than for many other branches of industry, for the majority of chemical works possessed well-organized sick-clubs, whose constitution it simply became necessary to bring into harmony with the new enactments. In the case also of insurance against incapacity for work and of old age pensions, it was only a question, at least for the majority of the larger factories, of transforming institutions already voluntarily established by the proprietors. Much more far-reaching, however, were the changes brought about by the peculiar conditions of insurance against accident, which mainly consisted in holding each industry, in its entirety, responsible for cases arising in the separate factories, and at the same time considerably enlarging the limits of the responsibility. The duties thereby imposed upon industry are doubtless very heavy. At the same time, as a result of the new order of things, a widespread and praiseworthy tendency towards the introduction of arrangements with a view to the avoidance of accidents has set in.

For the carrying on of the business involved in the insurance against accidents, a trade-confederation of the chemical industry of Germany has been founded, having its chief office in Berlin, and subdividing itself into eight sections, corresponding to the principal branches of manufacturing chemical activity. By means of these corporations, in addition to the fulfilment of their special functions, the obtainment has been secured of abundant statistical materials, which are consigned in the yearly reports published by the boards of administration. From the report for 1891 are taken the data to be found below as to the number of chemical factories, then existing in Germany, and of the workers employed therein.

In addition to the care, prescribed by the social-political laws, of the workpeople employed in factories, there exists in most of the larger chemical works a wide-spread voluntary solicitude for the well-being of the employed, by the erection of healthy and suitable dwellings and by the provision of rooms for refreshment, rest and meetings etc., and of workmen's kitchens, baths etc.

The representation of German chemical industry abroad, the enlightenment of the Imperial government as to its wants, as well as the profitable intercourse between one factory and another are provided for by the *Society* (founded in 1877) *for the Protection of the Interests of the chemical Industry of Germany*, whose business premises are in Berlin. The meetings of the Society, which give opportunity for oral interchange of ideas, take place every year in autumn in a different town. The journal published by the Society *Die Chemische Industrie* treats of all questions of interest to the industry.

An accurate view as to the number of existing factories, the nature of their products, the source of the materials required or produced by the industry, is given in the following work, edited by the secretary-general of the above Society, O. Wenzel, and appearing every other year at the publisher's Rud. Mückenberger in Berlin: *Address-book and catalogue of goods of the chemical industry of the German Empire*, a copy of which will likewise be found at the Exhibition.

It scarcely needs mentioning that the chemical factories are not evenly distributed over the whole empire, but have mainly settled in places where the conditions either for industrial activity generally, or for the carrying on of some particular department, appeared to be most favourable. For this reason an accumulation of chemical works has taken place in certain districts, and this fact has been taken into account in the establishment of the sections of the trade-confederations of the chemical industry. An enumeration of these sections, with particulars as to the factories which they embrace and the workpeople employed therein, gives a clear idea of the distribution of chemical factories over the whole empire.

Section I. Berlin. 884 concerns with 13596 workpeople. The capital of the Empire has naturally developed into an industrial centre also. A railway system, radiating in every direction, convenient waterways, which, on the one side, unite Berlin with the harbour-towns, and on the other with the Saxon brown-coal districts, constitute the principal advantages of this centre. As fuel, the Silesian coal and the Saxon lignite are both at its disposal.

Section II. Breslau. 497 concerns with 6267 workpeople. The excellent Silesian coal must be looked upon as the main cause of the development of this centre. For a few industries the mineral wealth of Silesia is also determinative.

Section III. Hamburg, with 735 concerns and 15337 workpeople, being the most important harbour in Germany, is a favourable locality for such branches of industry as are dependent upon export and import trade. For certain businesses the Customs arrangements of Hamburg have determined their settlement in the district belonging to this centre.

Section IV. Köln. 810 concerns with 16585 workpeople. The Lower Rhine was of old the most populous industrial centre in Germany. The extensive coal-beds of the Rhine and Ruhr districts, the extraordinary development of Rhenish metallurgy, the central position and at the same time, the connection with the ports of Holland by the waterway of the Rhine, constitute as many grounds for the development of the Lower Rhine industry.

Section V. Leipzig. 1090 concerns with 16478 workpeople. The Saxon industry is favoured by the abundant occurrence of brown-coal in the kingdom, as well as by the convenient communication on the one hand with the carboniferous districts of Bohemia, and on the other with Hamburg by the waterway of the Elbe.

Section VI. Mannheim. 418 concerns with 15683 workpeople. The grand-duchy of Baden and the Bavarian Palatinate have been especially singled out by chemical industry, because, owing to their convenient position on the Rhine, which is navigable as far as Mannheim, they are almost as favourably situated, as regards coal and certain imported articles (especially Spanish pyrites), as the districts of the Lower Rhine, and at

the same time, owing to the absence of metallurgical works, enjoy more favourable conditions as regards labour.

Section VII. Francfort a. M., 369 concerns with 10590 workpeople, enjoys, owing to its position on the navigable Main, similar advantages to those of the last named centre.

Section VIII. Nürnberg. 470 concerns with 5749 workpeople. Nürnberg and the neighbourhood are the seat of a greatly developed, and to some extent a very old, small-industry. The growing chemical industry in the neighbourhood of Munich belongs also to this section.

There existed in Germany in 1891 a total of 5273 chemical businesses with 100285 fully occupied and insured workpeople, who drew in wages for 29979280 workdays the sum of 83855957 marks.

To the visitor of the Columbian Exhibition at Chicago the German chemical industry presents itself in the form of a collective exhibition, organized in common, in which, it is true, only a portion of the numerous chemical factories of the German empire have taken part. The participants, however, can claim worthily to represent the industry, and to unfold a striking picture of the productive power of Germany. Exclusively of those branches which have no demand from beyond the seas, and therefore take no interest in transmarine exhibitions, nearly all departments of chemical activity are represented by prominent firms, whose products bear witness to the diversity and capabilities of their businesses. If the visitor will combine the contemplation of them with a study, (in the Exhibition of the Royal Prussian Ministry of Public Instruction), of the collection of the products of scientific chemical research, contributed by the German Chemical Society, he will gain a vivid idea of the active chemical life, which prevails at the present time in Germany.

In the following pages, the names of individual exhibitors will be given, together with such information regarding the magnitude and organisation of their business, as may claim to be of general interest.




I.

The industry of acids and alkalis.



In this group will be comprised all those chemical industries, which have been called, among other things, the larger chemical industry, a name which, in view of the enormous expansion of many other departments of chemical manufacture, can scarcely claim any longer to be distinctive. But the group itself stands today in a very different position from that which it occupied twenty years ago. Originally confined to the narrow circle of the Leblanc soda- and acid-industry, it was impelled, in Germany more than elsewhere, to assume vast proportions and to become in the highest degree diversified, first by the creation of the manure-industry which sprung from the labours of Liebig, then by the discovery and ever increasing applications of the Stassfurt deposits, and lastly by the apparition and triumphant advance of the ammonia-soda-process. Struggling for its very existence, the old larger industry found strength constantly to increase the store of its own special methods and the means, by continual enlargement of its sphere of activity, of opening out ever new fields of demand.

The manufacture of sulphuric acid has, in principle, remained faithful to the old process of the leaden chambers. Its progress lies in a refinement of the plant, a more judicious selection of the raw material, an enormous increase of production. In addition to large quantities of the pyrites occurring



abundantly in Germany, this industry, notably in the Rhine country, consumes Spanish Rio-Tinto-pyrites which, with a high percentage of sulphur and good burning properties, yield residues containing an amount of copper which more than covers the cost of carriage. In Rhenish Prussia and Silesia blendes are calcined, and in this way prepared, at the same time, for the production of zinc. The sulphurous acid, obtained by the calcination of other ores, is also everywhere worked up into sulphuric acid. Lastly the iron oxide from the gas-purifiers supplies a not inconsiderable proportion of the sulphur required by this industry.

The total production of sulphuric acid in Germany amounted in the year 1891 to 627392 tons, of which

138910	from German pyrites,
359480	„ Spanish pyrites,
75313	„ zinc blendes,
10000	„ gas-purification residues,
and 43689	„ the ores worked up in the metallurgical works of Freiberg, Oker and Mansfeld.

The value of this production amounted to about 15 million marks.

As a new branch of industry, must here be mentioned the manufacture of liquid sulphurous acid, which is delivered in wrought-iron bottles and finds numerous applications.

Of conspicuous importance is the manufacture of fuming sulphuric acid, according to the process proposed by Cl. Winkler, but considerably modified in practice. It is carried out on a large scale, and supplies the greater part of its production to the dye-factories. The output in 1890 amounted to 3963 tons, of the value of 324999 marks.

Many sulphuric acid manufactories work in connection with artificial manure-works, and supply the necessary acid for the disintegration of native und imported phosphorites.

The manufacture of nitric acid uses exclusively, as raw material, Chili saltpetre (nitrate of soda)—of this in 1890 1033100 tons were produced in South America, the consumption of Germany being 330418 tons, value in marks 53 millions. A part was used as manure, another part was worked up into

nitric acid, and the remainder transformed into potash saltpetre (conversion-saltpetre). The manufacture of nitric acid in Germany is in many places carried on independently by the aniline manufactories, which employ large quantities of this acid. The production of saltpetre takes place, in accordance with a process discovered by Grüneberg, by decomposition with Stassfurt potassium chloride. The production of saltpetre amounts annually to about 18000 tons of the value of 7 million marks.

A large proportion of the sulphuric acid produced in Germany serves for the decomposition of common salt, the resulting products being hydrochloric acid and sodium sulphate. In common salt Germany is richer than any other country on the earth. It is found in the form both of rock-salt and of brine. The hydrochloric acid produced from it is in large quantities consumed by the dye-works. The sulphate finds employment partly in the glass-works, and is partly worked up into soda by the Leblanc-process. The preparation of chlorine and chloride of lime is only carried out on a limited scale, the hydrochloric acid finding a ready sale as such. An interesting novelty in this department is the manufacture of liquid chlorine, which was introduced by the Chemical Works „Rhenania“ in Stolberg and comes into commerce in steel cylinders.

The process of soda-production according to Leblanc maintains its position, notwithstanding the sharp competition of the ammonia-soda-process, because with the former alone is bound up the production of the indispensable hydrochloric acid. The crude soda-solutions are transformed, on an enormous scale, into fused caustic soda-hydrate, the consumption of which is very large in the dye, paper and textile industries. The residues of the soda manufacture are far too large to find complete utilization and the bulk remains as a worthless encumbrance. A fair amount, however, is made use of for the production of sodium thiosulphate (hyposulphite, antichlor) large quantities of which are employed in papermaking and photography. A part of the sulphur contained in the soda residues is also extracted.

The Leblanc process has also been applied to the Stassfurt potassium-chloride and has proved itself eminently

suitable. Nor is any effective competition from the ammonia-process to be feared in this department, owing to the great solubility of potassium bicarbonate. On the other hand, attempts have quite recently been made, with conspicuous success, to decompose potassium chloride by electrical means directly into chlorine and potassium hydrate. The direct transformation of potassium chloride, electrically, into potassium chlorate, has also already attained considerable industrial importance.

The ammonia-soda-process rapidly established itself in Germany and is constantly gaining ground. The peculiar local conditions, necessary to its successful working, are found united on comparatively many points in the German empire. In these localities, ammonia-soda manufactories on a large scale have been established not only by E. Solvay, the founder of this industry, but also by native firms, and to their share, at the present day, fall 80 per cent of the total soda-production of Germany. On the other hand the endeavours of these factories, by the discovery of an independent hydrochloric acid process, to create a new soda-industry, capable of competing in its entirety with the Leblanc-industry, have failed up to the present time, notwithstanding many promising experiments, to turn out satisfactory results. In the ammonia-soda process, the absolutely worthless calcium chloride liquors, which are allowed to run away, are, like the solid residues of the Leblanc-process, the weak point in this otherwise so simple and ingenious method. The great purity of the ammonia-soda has stimulated those firms, which still adhere to the old process, to put upon the market, by means of improved methods, a distinctly purer product, at a much lower price, than heretofore.

Of the highest economical importance for the German empire has been the opening up and rational exploitation of the Stassfurt deposits of rock-salt, and of the residual salts connected therewith. These are by far the largest salt-deposits in the world. Notwithstanding the frequent occurrence of salt in Germany, there existed, previously to the discovery of Stassfurt deposits, a not inconsiderable importation of common salt. The working of the Stassfurt mines has not only put an end to this importation, but it has, at one blow, placed

Germany at the head of all salt-producing countries on the earth.

According to a communication from Dr. Franck, one of the pioneers of the Stassfurt industry, the German production of rock-salt and recrystallised salt amounted in 1891 to 2548600 tons, of the value of 34,3 millions of marks, whereas the next largest production, that of England only reached the figure of 2146849 tons, in value 22,3 millions of marks. The aforesaid colossal production of Germany is subdivided as follows:

Rocksalt	666802 tons	value 2 979 000 marks,
Crystallized or kitchen-salt	503200 " "	13469 000 "
Carnallite	906400 " "	} 17857 000 "
Kainite	472200 " "	

Of the rock-salt and kitchen-salt produced in Germany in 1890/91 there were consumed in the country for table purposes 358772 tons on which duty was paid

for industrial and agricultural purposes, duty-free
465438 tons, of this for the soda and chemical works
307400 tons and 86000 as brine.

Exports amounted to	196578 tons of which
to Austria	22000 tons
" England	12915 "
" Belgium	22538 "
" Holland	24030 "
" Russia	12279 "
" Sweden	13500 "
" Denmark	6091 "
" Australia	9000 "
" British India	57606 "
" other countries	9490 "

on the other hand there was an import to German coast-districts amounting to 26499 tons.

The average value at the mine or salt-works was for rock-salt 4,47 marks and for kitchen-salt 26,85 marks per ton.

The german soda-industry, which, in 1877, with a production of 42000 tons, was unable to supply the home con-

sumption — 27 000 tons additional being then imported — now works largely for the export trade.

In 1890, out of a total production of 195 000 tons, 33 200 tons were exported, whereas the imports amounted to only 1300 tons. The consumption of salt amounted to 275 000 tons of rock and recrystallized salt, and 80 000 tons in the form of saturated brine, as employed in the ammonia-soda process.

The importance of the industry of the Stassfurt residual salts is shewn by the following figures which represent the production of the year 1891:

143 487 tons	potassium chloride,	value	19 670 000 Marks
18 980 "	potassium sulphate	"	3 110 000 "
12 453 "	potassium-magnesium sulphate	"	963 656 "
28 559 "	magnesium sulphate	"	297 253 "
16 077 "	magnesium chloride	"	291 155 "

The production of potassium carbonate from potassium chloride by the Leblanc process was in 1890 carried on by 12 factories, with a total production of 23 000 tons. The excess of exports over imports amounted in 1890 to 9548 tons of the value of 3,6 millions of marks, whereas up to the year 1875 there was a considerable importation of this salt, more especially from Russia.

In addition to the important potassium and magnesium salts, the Stassfurt industry produced also boric acid from the boracite found in the locality, to the extent of 2000 tons of the value of about 700 000 Marks, and in 1891 from the mother-liquors of potassium chloride manufacture some 463 tons of bromine of the value of 1,1 million marks.

In conjunction with the larger chemical industry, certain other branches, also carried out on a considerable scale, have been developed. We refer especially to the industry, quite recently established in Germany, of the chromium salts, among which the sodium bichromate is rapidly gaining preference over the potassium salt, formerly in exclusive demand; and further, to the manufacture of water-glass, to the carbonic acid industry, to the production of oxygen, of the fluorides, of the cyanogen compounds etc. etc. on a manufacturing scale.

As the German industry of acids and alkalis works in the main for the home consumption and consequently is less interested in exports beyond sea than the other branches of the chemical trade, it will be found that only a small proportion of its members have taken part in the collective exhibition of the German chemical industry. Their names are quoted in the following pages.



Exhibitors.

1. Actiengesellschaft für chemische Industrie in Mannheim.

Managers: Jos. A. Böhm and G. F. Holland.

Carry on, in their factories at Rheinau (Baden) and Barmen, the manufacture of chemical products, principally liquefied gases, (carbonic acid, ammonia, sulphurous acid) and further ammonium, barium, strontium and metallic salts, liquid ammonia, boric acid, sodium nitrite and sulphide, carbolic acid, picric acid etc.

A large proportion of the products is exported. The business has largely expanded of late years. In the first year (1887) the returns only amounted to 460 000 marks, whereas at the present time they exceed 4 000 000 marks.

The share-capital is 1 000 000 marks and there are two hundred workmen and over 40 employés.

In addition to the manufacture of chemical products, the company deals extensively in chemicals of every description.

List of exhibits:

Acid: boracic, — carbolic, — carbonic liquid, — hydrochloric, — nitric, — picric, — sulphuric, — sulphurous anhydrous, — tartaric: Ammonia: aqua, — liquid anhydrous, — muriate (Salammoniac) — nitrate, — sulphate; Antimony: golden sulphide; Barium: chloride, — hydrate, — nitrate; Bleaching powder; Borax; Calcium chloride; Carbon bisulphide; Carlsbad salt artif; Chloralhydrate; Chlorine liquid; Copperas; Copper: muriate, — oxyde, — sulphate; Epsom salt; India-Rubber substitute; Iron chloride; — liquor nitric; Lead nitrate; Lime: bisulphite, — phenate; Magnesia: calcined, — carbonate;

Manganese borate, — chloride, — hydrated oxyde; Naphthaline; Potassium: bicarbonate, — chlorate, — permanganate, — sulphide; Sodium: bicarbonate, — bisulphate, — bisulphite, — carbonate, — chlorate, — hyposulphite, — monosulphite, — nitrite, — phosphate, — sulphate, — sulphide, — stannate; Strontium: carbonate, — nitrate, — oxalate; Sulphur: dichloride, — precipitated; Tin: chloride, — protochloride; Zinc chloride, — dust, — sulphate.

2. Actiengesellschaft für chemische Industrie, Schalke, Westphalia.

Manager: A. Hofmann.

This firm which has a share-capital of $1\frac{1}{2}$ million marks, carries on the manufacture of sulphuric and hydrochloric acids, and of potash from Stassfurt potassium chloride, according to the Leblanc-process. In connection therewith they also produce potassium and sodium sulphate, chromates, red prussiate, sodium sulphide and antichlor. As specialties must be mentioned the extraction of antimony compounds from the ores, and the preparation of barium compounds, zinc chloride, oxalic acid and oxalates. The value of these products, which are in part disposed of abroad, amounts to about 3 million marks.

There are employed in this factory which occupies 70 Prussian acres (Morgen) — 10 of which are roofed over — 350 workmen receiving a yearly wage of 320 000 marks. The number of chemists engaged is 7. 11 boilers with 637 square-meters of heating surface, and 27 steam-engines with a total of 240 H.P. are in activity. The company possesses its own branch line of rails, and its own rolling stock.

The factory was founded in 1872 and employed at first only 100 workmen.

List of exhibits: 96 to 98 per cent. Carbonate of potash (calcined), 90 to 92 per cent. Carbonate of potash (calcined), 80 to 84 per cent. Carbonate of potash (calcined), Caustic potash, Hydrated potash, Oxalic acid, Oxalate of potash, Bioxalate of potash, Oxalate of antimony, Oxalate of barium, Oxalate of ammonia, Oxalate of sodium, Oxalate of manganese, Hyposulphite of sodium, Chloride of barium (crystallised), Chloride of barium (calcined), Prussiate of potash, Nitrate of barium (crystallised), Chromate of potash, Bichromate of potash, Sulphide of sodium (light), Sulphide of sodium (dark), Chloride of zinc (fused), Chloride of zinc (granulated), Carbonate of barium, Sulphate of potash (crystallised).

3. Badische Anilin- und Sodafabrik, Ludwigshafen o/Rh.

This company possesses extensive plant for the manufacture of nearly all products of the larger chemical industry. But as they work mainly with a view to the requirements of their own tar-colour-works, the productions of which are, as it were, the centre of gravity of the whole concern, the full account of this firm will be given in the group III "Industry of tar-products and artificial colouring matters."

4. Chemische Fabrik Griesheim, Frankfort o./M., Limited.

Managers: L. Göckel, since 1856, J. Stroof, since 1871, J. Scharff, since 1888.

The firm, whose offices are in Frankfort o./M. carry on the manufacture of chemical products in their principal factory at Griesheim o./M. and in two branch establishments in Küppersteg near Cologne and Spandau. It is one of the most important of the kind in Germany. It was founded in 1856 with a share-capital of only 200000 fl., and started with the working up of gold and silver sweepings, and also, as one of the first, with the manufacture of artificial manures. In 1858 the manufacture of soda by the Leblanc process was taken up, and for this purpose the share-capital was doubled. In 1863 the sulphuric acid plant was increased and on that account the share-capital raised to 500000 fl. In 1864 followed the recovery of sulphur from the soda residues according to Schaffner's process. In 1865 a commencement was made with the roasting of Westphalian pyrites, which, however, in 1877, were replaced by Rio Tinto pyrites, the working up of these ores by the Duisburg copper-smelting works, in which the company was interested, having proved remunerative. The continuous expansion of the business necessitated in 1867 the connection of the works with the Taunus railway; then followed in 1871 another increase of the capital to 1000000 fl. and in 1872 a change to the new monetary standard with a further addition, making in all 1800000 marks. In 1886 is to be recorded the foundation of the branch establishment of Küppersteg. Of special interest is the manufacture, carried out by this firm since 1885, of pure 100 per cent sulphuric acid monohydrate by the freezing of ordinary English acid. At about the same period experiments were set on foot in connection with one of the most important problems of modern chemical industry, namely the electrolytic decomposition of the chlorides of the alkaline metals into free chlorine and the metal, which, at the moment of its formation, is transformed by interaction with water into its hydroxide. The chemical factory of Griesheim can boast of

having been the first, after 5 years of experiments, to accomplish, in 1890, the practical solution of this problem on a manufacturing scale. The firm has applied the process to the Stassfurt potassium chloride, and produces in this way pure caustic alkali in solution and in the solid form, chlorine, chloride of lime and hydrogen gas. It is also one of those which took up the manufacture, so long neglected in Germany, of the chromates, which dates from the year 1888. In 1889 was founded, at Spandau, another branch establishment, solely for the purpose of making concentrated sulphuric and nitric acids. Then followed in the same year, as a consequence of this development, the undertaking of the manufacture of explosives and the further raising of the capital to its present figure, namely 4000000 marks. This concern, in its growth, as we have sketched it, from small beginnings to its present magnitude, furnishes to some extent an image of the expansion, which, during the same period, has taken place in the whole chemical industry of Germany.

The firm gives occupation at the present time to 18 chemists, 10 higher employés and 900 workmen. The comfort of the latter is provided for by refreshment rooms, baths, dormitories, and the building of suitable workmen's cottages. There are in the three factories 28 boilers which consume annually 65000 tons of coal. Each factory is connected with a railway by a branch of normal gauge.

The output of this firm represents a total annual value of 7,25 million marks and consists of all the products of the larger chemical and the aniline-oil industries, as well as of explosives, among which the one which is known as "Deinite," was discovered in Griesheim. The 100 per cent. sulphuric acid and the products of the electrolysis of potassium chloride have already been mentioned.

The firm possesses patents in Germany and the United States, and works not only for the home market but also for export.

The exhibits¹⁾ of the firm are arranged in the following manner

A. Genetic exhibition of the Acid and Alkali manufacture.

It is supposed that one kilo of Pyrites has been used, and the products obtained, or those required in the circle of the manufacturing process, are exhibited.

1. Crude Materials:

Nitrate of Soda, Pyrites (Rio Tinto), Rocksalt, Limestone, Coal, Chrome-Ore, Potassium Chloride.

¹⁾ The vessels containing the exhibits are connected together by means of columns and chains, in such a way as to show the genetic relation between the raw, intermediate, auxiliary and final products.

2. By Products and Auxiliary Products:

Nitre cake, Salt cake, Nitric acid 40° Bé, Purple ore, Black-ash, Nitrate of Soda, Burned Limestone, Muriatic acid 20° Bé, Fused Chrome charge, Sodium sulphate, Sulphuric acid 66° Bé, Chloride of Sodium.

3. Final Products:

Nitric acid 48° Bé, Sulphuric acid 99.7%, Muriatic acid 20° Bé; Sulphur regenerated from Soda residues (free from Arsenic), Caustic Soda 128%, Sal Soda, Soda ash, Bichromate of Sodium, Bichromate of Potassium.

B. Genetic exhibition of Aniline-making.

Starting with 3 kg Coal-Benzene oil. — The products are exhibited, in the quantities obtained from 3 kg Coal-Benzene oil.

1. Crude Materials:

Crude benzene oil, Benzene 90°, Benzene 50°.

2. By Products:

Benzole, Toluole, Xylole, Solvent-naphta, Gasolene, Bisulphide of Carbon from Benzene.

3. Nitro Products:

Nitrobenzole (Oil of Mirbane), Binitrobenzole, Trinitrobenzole, Nitrotoluole, Orthonitrotoluole, Paranitrotoluole, Trinitrotoluole, Nitroxylole.

4. Amido Products:

Aniline, Aniline salt, Toluidine, Orthotoluidine, Paratoluidine, Xylidine.

C. Genetic exhibition of Caustic Potash manufacture by electrolysis.

It is supposed that 2 kg of Potassium chloride have been subjected to electrolytical decomposition. — The final products are exhibited as obtained from this quantity.

1. Crude Materials:

Chloride of Potassium, Burned lime.

2. Final Products:

Bleaching powder 35%, 110°, Caustic potash lye 50° Bé, Fused caustic potash 90%.

D. Genetic exhibition of the manufacture of explosives.

Quantities started with, 1 kg Benzole, 1 kg Phenole (Carbolic acid), 1 kg Toluole. — The finished or the intermediate products are exhibited thus, as obtained from the above-named quantities of crude materials.

1. Crude Materials:

Benzole, Carbolic acid, Toluole.

2. Half-finished Products:

Binitrobenzole, Sulphoacid of Phenole, Binitrotolole.

3. Finished Products:

Trinitrobenzole, Trinitrophenol (Picric acid), Trinitrotoluol, Deinite.

5. Chemische Fabrik Kalk, Company with limited liability,
in Cologne o/Rh., formerly Vorster and Grüneberg.

Partners: Commerzienrath Dr. H. Grüneberg, Julius Vorster, Friedrich Vorster, Richard Grüneberg.

The firm is the successor of Vorster and Grüneberg, whose name will for all time be associated with the development of the potash industry in Germany. Founded in 1858 by Julius Vorster sen. and Dr. H. Grüneberg, it began business in a small factory with 12 workmen. At first saltpetre was produced by the interaction of Chili nitrate of sodium and crude-potash, a manufacture started by Dr. Grüneberg in Stettin at the time of the Crimean war. This conversion-saltpetre had up to that time been unknown on the Rhine; the firm were, however, successful in introducing it into the important Rhenish-Westphalian powder industry, and completely to dislodge the hitherto exclusively employed East Indian saltpetre. The discovery of the Stassfurt so-called residual salts led, in 1861, to the foundation of a potassium chloride factory in Stassfurt. This new cheap source of potash suggested the transformation of potassium chloride into potassium carbonate by the Leblanc process, thus bringing about the creation of an industry which has attained high prosperity in Germany. The less pure potassium salts found application as manure, and induced the firm in the year 1864 to take up the manufacture of artificial manures generally, and in particular of the superphosphates. For similar reasons the working up of ammoniacal gas-liquors, in the first place those of the town of Cologne, was undertaken, and later on several branches were founded for the carrying out of this work, among others, one in Russia. The large consumption by the firm of sulphuric acid led to the installation of their own sulphuric acid works. In the year 1885 the superphosphate business was made into a separate one, and transferred to the company-by-“Commandite” of C. Scheibler & Co. in which the old firm retained an interest. In 1892 the firm Vorster and Grüneberg was transformed into the present one.

From very small beginnings this firm has, by the perseverance and industrial acumen of its members, as well as by the reinvestment of their savings — without exterior help — worked itself up into one

of the most important of its kind in Germany. The capital now amounts to $4\frac{1}{2}$ million marks; in the principal factories of Kalk near Cologne, and Leopoldshall near Stassfurt, some 700 workmen are employed; 25 boilers with a total heating surface of about 1700 square meters are in operation. In coal, for the most part ordinary coal, but partly brown-coal, 63000 tons are consumed annually. There are 22 steam-engines and one gasmotor. A branch line of railway of normal gauge, 3,6 kilometers long, and 1,1 kilometer of narrow gauge lines facilitate the carriage of the large amount of materials worked up, for the transit of which the firm also possesses, besides others, 36 cistern-trucks. 25 high class employés and 8 chemists compose the staff.

The raw-materials consist in the first line, of the products of the Stassfurt mines, carnallite, sylvinite, kainite; and in addition potassium chloride, sodium nitrate from Chili, pyrites, lime-stone, heavy spar, coal and gas-liquors. The products are in Leopoldshall-Stassfurt: potassium chloride and sulphate — the latter was for the first time produced by Vorster and Grüneberg from Kainite and also by the decomposition of Kieserite. In Kalk the products are; saltpetre, sulphuric, hydrochloric and nitric acids, potassium carbonate, soda, potassium ferrocyanide, barium chloride, sulphur and ammoniacal preparations of every description.

List of exhibits: Chloride of potassium, Sulphate of potassium, Hydrated Potash 96/98%, Carbonate of Potash 90/92%, 96/98%, Ferrocyanide of potassium, Sulphur, Nitrate of Potash, Nitrate of Sodium, Chloride of Baryum, Potash magnesia, Nitrate of Ammonium, Chloride of Ammonium.

6. Stassfurter Chemische Fabrik (formerly Vorster & Grüneberg), Limited, Stassfurt.

Managers: Dr. B. Bernardi, Otto Holtz.

This firm, as the name implies, has sprung from No. 5. The factory was founded in 1862 by Vorster and Grüneberg, and in 1871 was made into a limited company with a share-capital of 1590 000 Marks. In 1883 the firm became interested in the potash-mine Ludwig II, and for this purpose raised its capital to the present amount, namely 3 000 000 Marks.

The firm carries on its business in three separate factories, two of which are connected by a branch line of normal gauge, and the third by a line of narrow gauge with the State-railways. 9 superior employés and 2 Chemists conduct the work, in which 150 hands — among them 10 women — find employment. There are 12 boilers

equal to 500 HP. and 14 steam engines equal to 180 HP. in use. 2500 tons of fuel are consumed annually. The raw materials are Carnallite, Kainite potash, pyrites, saltpetre, lime. The products, which represent a yearly value of 1 450 000 marks, are potassium chloride, magnesium chloride, potassium-magnesium sulphate, magnesium sulphate, sodium sulphate, potassic manurial salts, sulphuric acid, bromine, bromine compounds, potassium ferrocyanide, potassium cyanide, urea. The four last named are synthetically prepared by a special patented process.

That in this factory potassium sulphate was for the first time prepared on a manufacturing scale from Kieserite by H. Grüneberg has already been stated in the account of the previous firm. It was also the first which extracted potassium chloride in a rational manner from Carnallite, by a process which, in its main features, is still in general use.

For the welfare of its working personnel the firm supplies baths, contributes to the sick-fund far in excess of the requirements of the law, provides free of cost for the care of sick relatives of the work-people, and for the systematic collection of funds for the benefit of widows, orphans and invalids.

List of exhibits: Potassium Cyanide KCN, Potassium Cyanate KCNO, Yellow Prussiate of Potash $K_4Fe(CN)_6 + 3H_2O$, Urea $CO(NH_2)_2$.

7. Verein chemischer Fabriken in Mannheim, Limited.

Managers: Dr. Schneider, A. Grumbach, Dr. Hasenbach.

The company is the proprietor of four factories:

Neuschloss, in the Grand-duchy of Hess, founded 1826,
Wolgelegen, in the Grand-duchy of Baden, founded 1850,
Heilbronn, in the Kingdom of Würtemberg, 1851, and
Luisenthal, in the Kingdom of Prussia, 1870.

Of these the three first named were originally independent undertakings, which combined in 1854 to form a limited company. Neuschloss in Hess is certainly the oldest soda-factory in Germany. All four factories were built as soda-works in accordance with the Leblanc process. As such they still continue to work, with the exception of Heilbronn, which, having a brine supply of its own, seemed predestined to the ammonia-soda manufacture. This factory was therefore, in the course of the years 1882—1887 remodelled into an ammonia-soda works, and has successfully developed itself as such. The output in soda of the Union of chemical works in Mannheim is, next to that

of the firm of Solvay, the largest in Germany. Of the majority also of its other preparations the Union is among the largest producers. The share-capital amounts at the present time to 3 300 000 marks. The value of its yearly output is 6 400 000 marks, The staff is composed of 20 chemists and 70 employés.

The 1400 workmen employed in the factories draw a yearly wage of 1 520 000 marks. 41 boilers of together 2000 H.P. and 109 motors of together 1500 H.P. are in activity. Of other portions of the plant the leaden chambers used for the production of sulphuric acid, with a total capacity of 40 000 cubic meters, and the 15 platinum boilers and dishes of a total weight of 300 kilogr. deserve especial mention. All the factories have railway connection with a total of 9 kilometers of normal gauge, and 6,8 kilometers of narrow gauge for interior transit. 63 railway trucks are the property of the firm. The yearly consumption of fuel is 90 000 tons.

The raw materials are those usually employed in the larger chemical industry, and in addition bauxite and dolomite for the production of aluminium and magnesium compounds. The productions cover the whole field of the acid- and soda-industry, and here it must again be pointed out that the Union produces soda both by the Leblanc process and by means of ammonia in accordance with a special method independent of Solvay's.

In provisions for the welfare of its subordinates the Union possesses: workmen's dwellings, garden allotments for families, dormitories for unmarried men, factory-kitchens and canteens at low prices, workmen's baths, and special waiting-rooms for workmen at one of the railway stations.

This firm has received at exhibitions Golden medals at Paris 1867 and at Karlsruhe 1877.

List of exhibits: Hyposulphite of Soda, Acetanilide, Carbonate of Soda made by the Ammonia Process (heavy, light), Bleaching Powder, Chloride of Lime, Chloroform (Original-Pictet), Caustic Soda (blue, white), Hydrate of Alumina, Sulphate of Alumina, Alumina Anhydrous, Sulphate of Soda (pure crystals), Sulphate of Copper, Soda Crystals, Sulphate of Soda, Bicarbonate of Soda, Magnesia Carbonate (calcined), Sulphate of Iron, Nitric Acid, Sulphuric Acid.

Trade-Mark.



II.

Manufacture of chemical preparations of every description.



The subject of the previous group, the larger chemical industry of the German empire, is after all, notwithstanding many peculiarities, but the equivalent counterpart of similar industries in other civilized countries. But in the industry of general chemical preparations, we have a branch of manufacture which has developed in Germany to an extent unknown in any other country in the world. The causes of this enormous expansion are various; only a happy combination of local advantages with the energy and perseverance of the representatives of this department of manufacture could have raised it to the height which it has attained.

The manufacture of finer chemicals of every description is that branch of the chemical industry of Germany which may demonstrably be shewn to be the direct outcome of the laboratories of the old apothecaries. In its incipient stage it confined itself exclusively to the preparation of remedies, but in proportion as the demand for the most varied chemicals became generalized, so the sphere of its activity was enlarged. The establishment of numerous laboratories, exclusively devoted to scientific research, involved a large consumption of chemical products of every kind. Very soon chemists discovered that, if they were to find time for the ever widening sphere of

their researches, they must refrain from preparing with their own hands the necessary reagents. It became more and more the practice in all laboratories for the chemist to buy those substances whose properties had already been determined, and to confine himself to the investigation of new compounds; the results thus obtained supplying the manufacturer, in many cases, with a basis for the enlargement of his business. By the introduction of galvanic batteries, and the consequent transformation of chemical reaction into electro-motive force, an abundant demand was created which, owing to the general adoption of electroplated articles, was still further increased. Again, an unbounded field was opened to the manufacturer of the finer and more valuable sorts of chemicals by the discovery of photography, which developed itself with amazing rapidity, and has now almost become the common property of all educated people. The dyers and the calico-printers, to whom the introduction of artificial dyes gave a most unexpected stimulus, set about transforming and remodelling their receipt-books, and turned their attention to the employment of chemical aids, which no man in the previous century could ever have dreamt of. Their example was followed by other trades, which, up to that time, had kept aloof from all chemical assistance. All these demands chemical manufacture was bound to supply. This it was able to do, the first enquiries for a newly adopted article being of a limited character, increasing only step by step. True, many a product, which has thus found its way into the arts, now enjoys so great a demand, that its present production is reckoned by thousands of kilograms, and many a branch of manufacture which commenced with an apparatus consisting of a few glass flasks and stoneware dishes, is now carried on with a powerful and ingeniously constructed plant, worthy to stand side by side with anything of the kind in the larger chemical industry. In other departments, however, the manufactory of chemical preparations has remained the same enlarged laboratory that it was at its starting point. In such cases, the high price of many a substance, prepared in small quantities, is the inducement to its continued production; refined execution of the methods of production, the use of steam

and certain mechanical appliances, the personal skill of workmen thoroughly familiar with the process, the reputation for certain articles obtained among consumers, are so many advantages which the manufacturer possesses over fresh competitors or consumers bent upon taking up the manufacture.

As a consequence of the extraordinary expansion and diversity of the department under consideration, there exists, as a matter of course, a striking dissimilarity between the factories belonging to it. As there is no single factory, however large some of them may be, which makes even an approach to the production of all the substances which are at the present time numbered among chemical preparations, so there are very few factories which are of the same character or even at all similar. Each factory has a certain number of products to which it devotes itself with especial zeal, and for which it has won a certain reputation. A lively interchange of products exists between the different factories of this branch, and there is also a large business done between the manufacturers of general chemicals on the one side, and the larger chemical industry and the great colour-factories on the other. The substances produced by the latter on a large scale are purchased by the manufacturer of chemical preparations, partly as raw materials for his own consumption, partly with the view of putting them, after purification, on the general market in smaller quantities and at a correspondingly higher price. It is intelligible, therefore, that these industries have many points of contact, and that it is difficult to draw a sharp line between them. Many factories belonging to the larger industry carry on certain branches of the minor chemical trade in conjunction with their own business, and the great dye works, which originally were merely a branch of chemical manufacture, have recently in many cases shewn a tendency to reversion, by taking up the manufacture of certain of the more refined and more costly products from the domain of organic chemistry.

The many-sidedness of the industry of chemical preparations and the constant change in which it moves, make the obtainment of complete statistical data, as to its condition, an

impossibility. Whereas, for the larger chemical industry, full statistical details are possible and even necessary, the very reverse is the case with the general chemical trade. However interesting from a scientific and economical standpoint it might be to ascertain in what quantities these general preparations are produced, and where the sometimes considerable quantities of rarer substances, scarcely known by name, and extracted from the most inaccessible raw materials, ultimately find their employment, the fulfilment of this desire must be given up as impracticable. As a measure of its capabilities, it may be said that there hardly exists a product, mentioned in chemical literature, whose manufacture the German chemical trade would hesitate to undertake, so soon as a demand for it should spring up, sufficient to insure its profitable production on a manufacturing scale. That, in the first line, it must lean for support on pure, chemical, scientific research, goes without saying. In fact the manufacture of chemical preparations, as well as the colour industry, could never have reached the height of prosperity which they have attained in Germany, except in connection with a highly developed and completely independent science of chemistry. — Although, as just stated, statistics of the manufacture of chemical preparations are not obtainable, numerical data are not wanting which enable us to form some conception of the importance of this industry in Germany. We borrow the following from a new work, based upon official materials, by H. Wichelhaus: "The economic importance of chemical work".

According to the Imperial industrial statistics for 1891, there were in Germany, 521 larger and smaller factories engaged in the manufacture of chemico-pharmaceutical and photographic preparations, whose 14842 workpeople drew 12615700 marks in wages. The number of preparations produced is unknown; at the same time the export from Germany, in 1890, of chemical preparations, not specially named, exceeded the imports by 5000 tons, valued at more than 15 million marks. To these must be added the chemicals, quoted by name in the official lists, and which are therefore not included in the above figures.

Aluminium preparations	13509	tons	value	2032000	marks,
Copper sulphate	3370	"	"	1348000	"
Sugar of lead	1446	"	"	651000	"
Antimony preparations .	296	"	"	636000	"
Tartaric acid	1003	"	"	2610000	"
Oxalic acid	859	"	"	491000	"
Benzoïc acid	41	"	"	159000	"
Salicylic acid	243	"	"	2671000	"
Chloralhydrate	32	"	"	92000	"

The total excess, therefore, of exports over imports of chemical preparations represented a value of 25 690 000 marks; if to this we add the home consumption, which must at least be equal to the excess of exports, we may estimate the value of the total production of general chemical preparations at, at least, 52 million marks annually.



Exhibitors.

1. Arsenic Mining and Metallurgical Works, "Reicher Trost" (H. Güttler) in Reichenstein, Silesia.

Proprietor: Hermann Güttler.

The firm carries on in Maifritzdorf and Reichenstein the manufacture exclusively of arsenical preparations, of a yearly value of about 300 000 marks. From ores of their own extraction they prepare: arsenious acid in powder and lumps, yellow and red arsenic sulphide, metallic arsenic. There are in the factory 175 workmen superintended by 5 higher employés and one chemist. Three boilers, with steam and gasmotors of together 154 H. P. are in use.

The Arsenic Mining and Metallurgical Works "Reicher Trost" is the most important establishment of its kind in the world and can boast of a very old and remarkable history. Originally it was founded, in all probability, as far back as the sixth century as a gold-mine, and as such was worked for many hundred years. Especially good yields were obtaining in the 16th century. During the 30 years

war, the gold mining fell into desuetude, nor was it possible, notwithstanding numerous attempts, to restore it to prosperity. In 1699 the production of arsenic on a large scale was begun but remained unremunerative, until in 1883 the works fell into the hands of the present proprietor, who remodelled them in accordance with present requirements and put them into regular working order. The extraction of the gold contained in the ores is, at the present time, carried on experimentally by electrolytic means, and with fair prospects of success. The quantity of gold in the calcined residues amounts to 33 grammes per ton.

The exhibits of the firm are as follows:

1. Model of the mine "Reicher Trost" near Reichenstein. 2. Crude ore from the mine "Reicher Trost." 3. Products of the factory: washed arsenical pyrites, white sublimated arsenic powder, doubly refined vitreous arsenic in lumps; yellow arsenic in lump and in powder: red arsenic in lump and powder, grey metallic arsenic in crystalline lumps and powder, residues of calcined arsenic pyrites; an octahedron of gold representing the amount of gold contained in a ton of residues.

2. Berliner Capsules-Fabrik, Berlin.

Proprietor: Joh. Lehmann.

This factory, the oldest of its kind in Germany, was founded in the year 1835 by the apothecary C. Kaumann, and has attained, especially during the last five years, its present magnitude, after having taken up the manufacture of Sommerbrodt's creosote-preparations. The factory occupies about 70 workwomen, and prepares gelatine-capsules and pearls, both empty and full of medicines for medical and other purposes, especially Prof. Dr. Sommerbrodt's original creosote capsules; and in addition, compressed tablets, pills, dragées and other similar articles. The firm was awarded a gold medal at Rheims and Cologne o. Rh. and a silver medal at Melbourne, Brussels and Barcelona.

Trade-Mark.



3. J. Bernhardt, Leipzig.

Proprietor: J. Bernhardt.

This firm, founded in 1866, deals extensively in vegetable drugs, and works them up into the customary forms, as demanded by the pharmacist, that is to say by cutting, rasping, powdering and crushing. It prepares also from these drugs all extracts in general use, Galenic products, fatty and ethereal oils and essences. A specialty of this firm is the production of natural colouring matters: Chlorophyll, alkanine and bixine. The commercial value of the entire produce was, in 1892 = 1350000 marks. The firm occupies 50 workpeople, and 20 overseers, clerks and chemists. For the driving of the grinding and other machinery there is a boiler of 40 HS. and 2 boilers of 120 square meters heating surface.

The firm exhibited at Philadelphia and was awarded a medal.

The exhibits of the firm are shown in 8 separate subdivisions.

The first and largest embraces the pharmaceutical, and especially the Galenic products; the second, the products of the steam drug-grinding mill and drug-subdividing machinery.

The other subdivisions contain respectively:

- a) European poisonous drugs, especially of vegetable origin,
- b) European medicinal flowers,
- c) European medicinal plants of various kinds,
- d) European plants, more especially of an aromatic nature,
- e) various European drugs.

Attention is called to the large number of quadrangular compressed packets, exhibited at the back of the show-case, and containing 100 g, 50 g, 25 g of substances the nature of which is indicated by a pictorial representation. In the middle of the case are larger compressed bales and packets, of the most varied shapes and sizes, showing the method of packing for export.

The whole 400 exhibited glass-vessels, containing samples of the wares, are provided with labels bearing the name and the price (several prices indicate different qualities). The prices represent the quotations of the firm in December 1892 for large quantities per pound English f. o. b. any European port.

4. Brüder Richter, Leipzig.

Proprietors: Hermann Richter, Julius Richter.

The factory was founded in 1877 and is engaged in the preparation of essential oils, essences and chemicals from the most various seeds, of which 100 tons are worked up annually. The staff is com-

posed of 1 chemist, 4 employés and 6 workmen. A boiler and steam-engine are in use. The products are exported to all parts of America.

The factory produces and exhibits: essential oils, essences, chemicals (thymol, menthol etc.) of perfect purity. Special attention is called to the liquor- and fruit-essences, equal in perfume and flavour to the products of nature.

5. Chemische Fabrik auf Actien, vorm. E. Schering in Berlin, Limited:

Managers: J. F. Holtz, H. Finzelberg, W. Dittmar.

This is one of the most important factories in Germany. It was founded in 1852 by Ernst Schering in connection with his establishment in Berlin, Chausseestrasse 19, called the "Grüne Apotheke" (green apothecary's shop), which is still carried on by his son R. Schering. Immediately on taking possession of this apothecary's business, Schering started the manufacture of various products among which may be mentioned silver nitrate, iodine and bromine salts, and pyrogallie acid. In so doing, he made it a principle to bring into commerce only such preparations as were in the highest state of chemical purity. The demand for these products assumed in consequence such proportions that the arrangements of the apothecary's shop soon proved inadequate, and it became necessary to devote additional space, though not at first to any considerable extent, to manufacturing purposes. This was all the more necessary, as the great development of photography, which took place just at that period, suggested to Schering the desirability of adding the requisite products to his list. Very soon the freehold in the Chausseestrasse became insufficient, and Schering saw himself compelled to purchase in the neighbourhood, namely in the Fennstrasse and Müllerstrasse, four pieces of land and thither to transfer gradually the manufacture of a portion of his articles. After the completion of the necessary buildings, to the manufacture of pure acids, of preparations of bismuth, iron, potassium, lithium, sodium and zinc, of tannin and pure glycerine, the following were added: carboic acid, barium and strontium salts, chloral-hydrate, iodoform, permanganate, tartar emetic and many others. In 1871, the factory was converted into a limited company with a capital of 1500000 marks. All manufacturing work was conveyed to the factory in the Fenn- and Müllerstrasse, while the "Grüne Apotheke" remained in Schering's possession. At the same time he became the manager of the new company. The rapid expansion of the business made it necessary to appoint a second manager. As such J. F. Holtz was elected, who had

up to that time possessed the Royal Court-Pharmacy in Charlottenburg, in which he also, in a small way, had devoted himself with success to the preparation of chemicals. Mr. Holtz is still a director of the company. The inception of ever new products, and the constantly increasing demand for the Schering manufactures soon rendered further enlargements indispensable. In 1880 other premises were acquired in Charlottenburg and the share-capital raised to its present amount of 3000000 marks. In Charlottenburg the first preparations attempted were those requiring the employment of large quantities of alcohol. An extensive ether factory was put up, which, by the way, had already become necessary for the firm's large production of tannin. Later on, such articles were manufactured in Charlottenburg as are prepared by electrical means. The dynamos erected for these purposes require a driving power of 200 HP.

Soon after the building of the Charlottenburg factory, Schering became a member of the board of directors of the company and continued in that capacity until the day of his death which took place in 1889. In the year 1882, Herr H. Finzelberg, who commenced his career in Schering's pharmacy and, later, had carried on a factory of chemical products at Andernach o./R. also became a manager. In the year 1889 the company decided to erect, on their premises in the Müllerstrasse, an extensive building to be exclusively devoted to the commercial requirements of the firm, and the space thus set free was utilized for the production of a series of new articles among which we quote chloralamide (chloralformamide) chloral-chloroform, celloidine, creosote, levulose, lactic acid, phenocol, piperazine, paraldehyde, salol, boric acid, scale preparations etc. In the year 1893 Herr W. Dittmar, for many years entrusted with the procurement of the firm, was appointed co-manager (in commercial matters).]

And so in the course of less than 40 years, from the smallest beginnings, a business has grown up which may be reckoned among the most important, and whose yearly turn-over amounts, in round numbers, to 10 000 000 marks.

The excellence of the preparations of this firm has been acknowledged by rewards at all the exhibitions to which it has contributed. These were at Paris 1855: Silver medal, London 1862: Two Bronze medals, Berlin 1865: Bronze medal, Paris 1867: Silver medal, Vienna 1873: Bronze medal, Philadelphia 1876: Bronze medal, Sidney 1880: Bronze medal, Leipzig 1880: Silver medal, Melbourne 1880: Golden medal, Antwerp 1885: Golden medal and Diploma, Berlin 1889: Silver medal. Above all, in 1879, on the occasion of the Berlin Indu-

strial Exhibition, the firm was awarded the great Gold State-Medal of Frederick William IV.

The firm occupies at the present time 60 employés, among whom 14 chemists. There is a personnel of 450 workmen. 14 boilers of together 1380 H.P. do service in the factory. There are 26 steam-engines of together 375 H.P. which drive, among other things, 27 water- and air-pumps. The factory is connected by its own rails with the Berlin railways. The fuel used amounts to 1500 tons annually. The products of the firm have been enumerated in the historical survey. The firm possesses numerous patents, and exports a large proportion of its output to all parts of the world.

For the well-being of its workpeople the firm provides in the most elaborate manner. There is for employés and workpeople a special pension-fund, securing to such as have become unfit for work an amount which, according to length of service, may be equal to two-thirds of the salary or wage. There are also sick- and death-funds for the wives and children of workmen, and a maintenance-fund for widows and orphans. A premium-fund (Schering-foundation) assures to every workman, after twenty years service, a premium, paid once for all, of 100 marks. The weekly wage averages 15 to 22 marks, and for specially gifted workers 22 to 30 marks.

List of exhibits: Tartar Emetic, Boric Acid, Bromide of Ammonium, Bromide of Potassium, Bromide of Sodium, Benzonaphtol, Bismuth Metallic, Camphoric Acid, Carboic Acid, Celloidin, Chloral-amid, Chloral-Coffeine, Chloral Hydrate, Chloroform from Chloral, Crotonchloralhydrate, Cyanide of Potassium, Diabetine, Gallic Acid, Gallate of Bismuth, Glycerin, Iodine resublimed, Iodoform, Iodide of Cadmium, Iodide of Potassium, Creosote from beech-wood tar, Kresin, Lactic Acid, Monochloracetic Acid, Monobromate of Camphor, Magnesium Metallic (powder), Naphtalene (chemically pure), Paraldehyde, Piperazine, Permanganate of Potassium, Pyrogallic Acid, Salicylic Acid, Salicylate of Bismuth, Salicylate of Sodium, Salicylate of Piperazine, Salol, Nitrate of Barium, Nitrate of Strontium, Subnitrate of Bismuth, Phenocoll Hydrochloride, Sulphate of Copper, Sulpho-Carbolate of Zinc, Tannic Acid.



6. Chemische Fabrik Bettenhausen, Marquart & Schulz, Bettenhausen-Cassel (Hess).

Proprietors: Dr. Paul Marquart and Arthur Schulz.

This factory, founded in 1876, produces with a personnel of 70 workmen, chemical and pharmaceutical products of various kinds, raw materials for the manufacture of aniline-dyes and auxiliary products for bleaching, dyeing, calico-printing and finishing. Three chemists and 6 higher employés superintend the works. The firm possesses patents in Germany' and exports a portion of its production to the United States, England, France, Russia, Austria, Switzerland and Italy.

List of exhibits:

Peroxyde of lead paste, Peroxyde of lead powder, Plumbate of lime, Plumbate of lime in bricks, Plumbate of strontia, Plumbate of baryta, Sulphide of iron in lumps, Sulphide of iron in small lumps, Sulphide of iron granulated, Sulphide of iron in sticks, Sulphide of iron in powder, Phosphoric acid vitreous in sticks, Phosphoric acid vitreous in lumps, Phosphoric acid anhydrous, Phosphoric acid crystallized, Phosphoric acid syrupy, Phosphorus trichloride, Phosphorus oxychloride, Phosphorus perchloride, Pyrophosphate of soda, Pyrophosphate of iron, Hydrated oxide of manganese, Chloride of manganese free from iron, Chloride of manganese anhydrous, Chloride of manganese fused, Carbonate of manganese, Resinate of manganese, Chloride of zinc white, free from iron, Chloride of zinc grey, Borax, Boracic acid, Acetic acid anhydrous, Acetyl chloride, Acetine, Acetamide, Monochloroacetic acid, Ethylsulphonate of soda, Bisulphite of potash (meta), Bisulphite of iron, Bisulphite of alumina, Bisulphite of chromium.

7. Chemical Works, formerly Hofmann & Schötensack, Limited, Ludwigshafen o. Rh.

Capital 900 000 Marks. Manager Fr. Böckel. Works manager Gustav Auerbach.

The factory was founded in 1871 by Saame under the style of Saame & Co. and limited itself for a time to the production of chloralhydrate. It passed subsequently into the hands of Dr. P. W. Hofmann and Otto Schötensack and, under the new firm of Hofmann & Schötensack, extended its field of production to other pharmaceutical preparations and more especially to some of the secondary raw materials of the dye-industry. In 1881 it was converted into the present limited company.

The factory with a personnel of 5 chemists, 20 employés and

120 workmen, carries on the manufacture of a large number of different preparations of the total value of between 600 000 and 800 000 Marks annually. In addition to the principal products viz Chloral-hydrate, salicylic acid, salol, salacetol, potassium permanganate, the following are also prepared: preparations of iron, manganese, zinc and lead, chemically pure acids, hydrogen peroxide, sulphites, potassium cyanide etc. etc. The factory possesses 6 boilers and 2 steam-engines, its own connection with the railway and its own trucks for the carriage of acids.

8. Chininfabrik Braunschweig, Limited.

Managers H. Buchler, A. Hahn.

This factory founded in 1858 by H. Buchler was transformed in 1871 into the present limited company.

Its specialties are the alkaloids, and especially quinine and the secondary alkaloids of the cinchona bark, also cocaine, tropacocaine etc.

The company possesses the German and American patent for the synthetical production of Cocaine (Prof. Dr. Liebermann and Dr. F. Giesel) — it has exported for many years to the United States where its products enjoy the best reputation.

List of exhibits: Sulphate of Quinine Brunswick, different Salts of Quinine, Sulphate of Quinidine, Sulphate of Cinchonidine, Muriate of Cocaine, Cocaine pure Alcaloid, Hydrochlorate of Tropacocaine, Other products of Coca leaves.

9. Farbenfabriken, vorm. Friedr. Bayer & Co., Elberfeld, Limited.

This firm produces a number of preparations for pharmaceutical use. As however its main object is the manufacture of artificial dyes, we reserve our account for group. III. „Industry of tar-products and artificial colouring matters“ (p. 73).

Products of the firm are: Phenacetin, Sulfonal, Trional, Tetro-nal, Salophen, Aristol, Europhen, Losophan, Salicylic Acid and its salts, Salol, Chlormethyl, Chlorethyl, Bromethyl, Piperazin, Antinonnin.

10. Goedecke & Co., Leipzig.

Proprietors: Mrs. Elise Goedecke, Max Perschmann.

This factory was founded in 1866 and is concerned with the production of etherial oils and essences. It exports a large proportion of its production, more especially to Russia and the United

States; to the latter, as a specialty, East and West Indian Sandalwood oil. Resident agent in New-York: E. Marchi, 162, Pearl Street.

List of exhibits:

Essential Oils: Angelica oil, Anis Russian oil, Anis Stearopten oil, Valerian oil, Amber oil (rectif.), Calamus oil, Cardamom oil, Cascarilla oil, Cedarwood oil, Camomile oil, Cognac oil, Copaiva oil (East India), Coriander oil, Cubebs oil, Cumin oil, Dill seed oil, Fennel oil, Fennel Stearopten oil, Galanga oil, Hop oil, Hyssop oil, Ginger oil, Caraway oil (Dutch), Caraway oil (German), Caraway Carvol oil, Pine pumilionis oil, Lovage oil, Mace oil, Marjoram oil, Almonds oil (bitter), Almonds oil (bitter artificial), Cloves oil, Origanum oil, Patchouly oil, Parsley oil, Pimento oil, Tansy oil, Savin oil, Sage oil, Sandalwood Bombay oil, Sandalwood West India oil, Milfoil oil, Snakeroot oil, Celery oil, Mustard seed oil, Mustard oil, artificial, Juniper berries selected oil, Juniper berries oil (twice rect.), Juniper berries oil (rect.), Cinnamon oil.

Menthol. Thymol.

Fruit Essences: Apple essence, Strawberry essence, Raspberry essence.

Essences: Cognac essence (fine Champ.), Ginger essence, Rhum essence Jamaica, Rhum essence Jamaica (extra strong), Rhum essence Kingston (extra strong), Gin essence.

The products of this firm has been acknowledged by rewards at the Exhibition at Philadelphia 1876.

11. Th. Goldschmidt in Essen-on-th'e-Ruhr.

Proprietors: Dr. Karl Goldschmidt, Dr. Hans Goldschmidt.

This factory was founded in Berlin, in 1847, by Th. Goldschmidt, who died 1875, the father of the present proprietors, with the special object of supplying the wants of the dye-houses, and manufactured, therefore, on no insignificant scale, starch preparations, metallic mordants, especially tin-salts, and for a time murexide. Since 1882, that is to say, after the accession of the present proprietors, the factory has rapidly expanded. Owing to the adoption of new manufactures, among which must be named the chlorides of phosphorus and more especially the electrolytic extraction of tin, the business developed so rapidly that a continuation in the old premises became impossible. The proprietors decided, therefore, to transfer the factory from Berlin to Essen, where conditions are more favourable, and this was carried out in 1889—1891. In the electrolytic

production of tin, for the first time accomplished on the large scale by this firm, 2 dynamos of 200 H.P. are employed. In addition to the above-named products the firm manufactures also zinc salts. In its new home the business has prospered, and to its old specialties has added the preparation of sodium phosphate. For the independent testing and working out of the various problems connected with the dyeing and weighting of silk, the firm maintains a special laboratory under the superintendence of a chemist and a dyer.

List of exhibits: Tin crystals (chem. pure), Perchloride of Tin, Stannate of Soda, Phosphate of Soda, Chloride of Zinc, Chloride of Manganese (cryst.), Chloride of Manganese (calc.), Chloride of Phosphorus.

The firm also exhibits samples of cotton goods, velvets, muslins and skeins of silk, which illustrate the application of its products to practical purposes, also railway-sleepers, treated with zinc chloride, which have successfully stood 10 and 26 years use.

12. Haarmann & Reimer, in Holzminden, Society by "Commandite".

Proprietor: the manager of the factory Dr. Wilhelm Haarmann in Höxter.

Consulting Chemist: Prof. Dr. Ferd. Tiemann in Berlin.

To the firm Haarmann & Reimer, together with the firm of G. de Laire & Co. in Paris, which is closely connected with it, the credit is due of having founded the industry of artificial perfumes. Up to the beginning of the seventies, in addition to the substances supplied to us by nature, the only perfumes manufactured were essence of mirbane (nitrobenzol) and the so-called fruit-ethers, which in delicacy of odour were not to be compared with those they were intended to substitute. After the successful preparation in 1874 of artificial vanilline by Mess. Tiemann and Haarmann, the factory in Holzminden was erected by Dr. W. Haarmann for the technical exploitation of the discovery. In 1876 Dr. Karl Reimer went in as a partner and the style of the firm was altered to Haarmann & Reimer. This designation remained after the death of Dr. Reimer, and was transferred to the society "by Commandite" founded in 1892.

During the first four years of its existence, the factory produced vanilline exclusively, together with a few scientific preparations. In 1878 the manufacture of heliotropine, the perfume of the heliotrope, and of coumarine, the perfume of the tonka-bean, was undertaken. The business then gradually developed into a manufacture of perfumes of every description, which were produced in a state of perfect

purity and so sent into commerce. The elaboration of the methods employed in the factory was the work of the three founders already referred to, and with them were associated: for heliotropine and coumarine Dr. C. Köhler, for terpineol (1889) Dr. P. Krüger, for linalool and linalool-acetate Dr. Fr. W. Semmler.

The factory occupies at the present time 39 workmen; they are superintended by 4 chemists and 3 administrative employés. There are 2 boilers of 234 sq.meters heating surface, 4 steam-engines of together 29 H. P. and one water-wheel. In addition to the products already named, the manufacture of which was created by the firm, they produce a number of perfumes and preparations enumerated in the list of exhibits. The processes in use are in part protected by a large number of patents both at home and in foreign countries.

For the welfare of the workmen employed, who for a day's work of ten hours are paid from 2,50 to 2,90 marks, the firm make the most thorough provision. To their married workmen they offer at a very low rent healthy cottages, consisting of 2 rooms with fire-places, 4 sleeping rooms, kitchen, cellar, yard, outhouses for cattle and $\frac{1}{4}$ of an acre of land and garden. Some of the men, with the assistance of the firm, have become free-holders. In the factory hot coffee and baths are provided free of charge; at Christmas-time the workmen receive presents and savings-bank-deposits.

The following preparations are exhibited:

Vanilline, heliotropine, coumarine, glycovanilline, methylvanilline, coniferine, vanillic acid, protocatechuic acid, veratric acid, pyrocatechine, paroxybenzaldehyde, coumaric acid, anisic acid, piperine, piperic acid, piperonylic acid, homopiperonylic acid, cinnamic acid, cinnamic methylether, terpenhydrate, terpineol, benzophenone, acetophenone, eugenol, iso-eugenol, linalool, linalool acetate, vanilline sugar.

Trade-Mark.



13. E. de Haën, Chemical Works, List near Hanover.

Proprietor: Commerzienrath Dr. Eugen de Haën.

The factory was founded in 1861 by its present proprietor, and has since then continuously developed until it has attained its present proportions, occupying, as it does, an area of 5 hectares. It is engaged in the manufacture of a great variety of chemical preparations for technical and pharmaceutical purposes, which find a market in nearly every country in the world. A large number of chemicals have been produced for the first time on a large scale, and brought into commerce, by this firm; quite recently, for example, the double combinations of antimony chloride with the sulphates and chlorides of the alkali-metals, which, as substitutes for tartar-emetic, have found extensive application in dyeing. The production of these salts is patented in the United States as well as in Europe.

The firm gives occupation to 45 technical and commercial employés, 16 chemists and 350 workmen. 7 boilers of 650 square meters heating surface and 16 steam-engines of together 150 H.P. supply the necessary steam and motive power.

The exhibits of the firm embrace some 400 different chemicals of every description for technical and pharmaceutical purposes.

14. Heine & Co., Leipzig.

Proprietors: Otto Steche, Theodor Habenicht, Dr. Albert Steche, Hans Steche.

The factory of ethereal oils, essences and chemical products of Heine & Co. was founded in 1853 by Dr. jur. Carl Heine (who so largely contributed to the development of Leipzig) in partnership with the chemist E. Sachsse under the style of G. Emil Sachsse & Co. From very modest beginnings the business soon developed to ever increasing importance. In 1859 Sachsse retired, and Dr. Heine, the sole remaining proprietor, continued to carry on the firm, after taking into partnership his co-workers Otto Steche and Joseph Becker, under the style of Heine & Co. A period of active development followed, during which, in particular, the foundations of an export trade were laid. In 1875 J. Becker died and Th. Habenicht became a member of the firm. In the course of the following years, the methods for the preparation of so-called concentrated oils and for the obtainment of artificial mustard oil were worked out. In 1888 Dr. Heine died, and Dr. Albert Steche who had previously acted as chemist to the firm became a partner in 1889, and lastly also Hans Steche

on the 1st march of this year. The present factory buildings cover an area of 4000 square meters and are in all parts heated by steam and lighted by electricity. The business connections of the firm extend over the whole world and are carried on by 93 agents and 6 travellers. The general agency for New-York is entrusted to the firm of George Lüders, Chicago and New-York, 218 Pearl Street. The representation in Central and South America is in the hands of Mess. Bosco & Ceresole, Buenos-Ayres and London. The firm has only contributed to universal Exhibitions, and has received prizes in Paris 1855, London 1862, Vienna 1873, (Medal for progress) and Barcelona 1888 (highest award, gold medal).

The firm occupies 40 persons, and carries on its manufactures by means of 3 boilers of together 200 HP. and 2 steam engines of 56 HP. As raw-materials it works up native and foreign leaves, blossoms, resins, woods, barks, seeds and roots, from which it extracts by various processes, but principally by distillation, all kinds of ethereal oils, quintessences from ethereal oils, and also prepares oils, artificial substitutes of ethereal oils, fruit ethers, essences and artificial perfumes of the most varied descriptions. As by-products exhausted chips are obtained for agricultural purposes, also food for cattle. The total value of the production amounts to 6—700000 marks annually.

List of exhibits:

Patchouly Oil, Santalwood Oil, Orris root Oil florentine, Anethol, Carvol, Geraniol, Linalool, Thymol cryst., Anisic aldehyde (Aubépine), Citral, Cognac Oil artificial, Coumarin cryst., Heliotropin cryst., Oil Mustard artificial, Tanacetone, Terpeneol (Lilacine), Wintergreen Oil artificial (Gaultherol).

Trade-Mark.



15. Dr. F. von Heyden Nachfolger, Radebeul near Dresden.

Proprietor: Dr. Carl Kolbe.

This factory, founded in the year 1874 by Dr. F. von Heyden, was at first exclusively concerned with the production of salicylic acid and its salts, in accordance with the method discovered by

Prof. Kolbe, and thereby attained a high degree of prosperity. By continuous technical improvements of the working-methods, by the discovery, adoption and introduction of new preparations, especially for medicinal use, it has step by step largely developed. It maintains an extensive scientific laboratory for the solution of problems arising in the works, and is in a position, as regards many of its specialties, to supply the needs of the whole world. Of special importance to the business must be mentioned the modified method, discovered by Prof. Rudolf Schmitt, of producing the aromatic oxycarbonic acids, in which carbonic acid is made, under pressure, to react upon the alkaline salts of the phenols. Attention must also be called to the preparation undertaken by this factory of the salicylic ethers of the phenols, the salols, discovered by Prof. von Nencki, and now enjoying considerable favour as remedies. In the factory itself were discovered by Dr. R. Seibert the disinfectants or remedies (as the case may be), solutol, solveol, guiacol and creosote carbonate, and by Dr. Hähle synthetical methods for the preparation of the, at one time, difficultly obtainable pyrocatechuic acid and pyrocatechine, and also of its pure monomethylether, guiacol. In addition to these products, the following were also introduced into commerce by the factory: salicylic acid and its salts, creosotini; acid, oxynaphtoic acid, paroxybenzoic acid, salol, betol, cresalol, benzonaphtol, oleocresote, solveol, solutol, sucrol, the bismuthic compounds of various phenols, salicylamide and dithione. These and other substances are mostly prepared under the protection of numerous home and foreign, and in particular, of American patents.

The workmen in the factory earn a yearly average wage of 1000 marks per head. In addition to the arrangements prescribed by law, the firm has created quite a number of institutions for the welfare of the workpeople. The following are deserving of note: restaurant and canteen in the factory; increased pay on seniority; savings-bank for workmen; baths and workmen's dwellings. The factory also takes upon itself the whole of the contributions for pensions in cases of incapacity for work and of old age. Lastly a pension fund, both for workmen and for employés, is in course of formation.

Trade-Mark.



16. Em. Kern, Edenkoben (Rhenish palatinate).

Proprietor: Em. Kern.

The factory, founded in the year 1835, carries on the manufacture of Cognac oil, Tierra di vino, argals, cream of tartar und Seignette salt. Its products gained a prize at the Antwerp exhibition 1885. The exhibits are, among others: Cognac oil in three different qualities or sorts, that is to say, green, yellow and water-white. Tartar pure, raw and refined.

17. Knoll & Co., Ludwigshafen o. Rh.

Proprietors: Dr. Albert Knoll, Max Daege, Hans Knoll.

Founded in 1886, the factory devotes itself, in the first line, to the production of alkaloids and glycosides; and as a specialty to that of the alkaloids of opium. In addition it manufactures salicylic acid and salicylates, also salol by a special process invented by Dr. Paul Ernert, lithium salts and new medicines, among which must be quoted diuretine, whose action was investigated by Prof. von Schroeder, of Heidelberg, and styracol.

The following special preparations of the factory are exhibited:

Acid carbolic, — detached crystals, — salicylic, crystals and powder, Antifebrine, Apomorphia muriate crystals, Bromoform, Caffeine pure crystals: Benzoate of soda and caffeine, Salicylate of soda and caffeine, Cocaine muriate crystals, Codeine pure crystals, — muriate, — phosphate, — sulphate, Diuretin-Knoll, Lithia benzoate, — carbonate, — citrate, — salicylate, Morphia pure crystals, — acetate, — muriate, — sulphate, Phenacetine, Salol, Salicylate of soda crystals and powder, Styracol, Theobromine.

Trade-Mark.



18. Rudolph Koepf & Co., Oestrich in the Rheingau and Schierstein o. Rh., Society by "Commandite".

Partners: Rudolph Koepf, Dr. C. Wachendorff, Hermann Wachendorff.

The factory was founded in the year 1861. and devoted itself exclusively at first to the manufacture of oxalic acid and oxalates. In 1886 the manufacture of antimony salts and chromates was added:

in 1891 a branch establishment was erected at Schierstein o. Rh. specially for the production of hydrofluoric acid.

The factory has now attained considerable magnitude; it occupies 200 workmen, and the staff is composed of 4 chemists and superintending employés. The work is carried on by means of 7 boilers of together 580 square meters heating surface, and 18 motors of together 125 HP. 12000 tons of coal are annually consumed.

The raw-materials are: potash, sulphuric acid, lime, saw-dust, antimony-ore, chrome-ore, fluorspar, etc. The products are enumerated in the list of exhibits. It deserves however to be mentioned that the firm was the first in Germany to manufacture oxalic acid and oxalates from saw-dust. It was also the first to introduce into commerce fluoride of chromium, double fluoride of antimony and antimony salt, products which have rapidly established themselves in the dye- and cotton-printing industries. Various patents protect in the German empire, as well as in the United States, on the one hand the processes used in the factory, and on the other the modes of application of the products which it has introduced into commerce. A large proportion of the output of the firm is exported to foreign countries.

For the welfare of its workpeople, in addition to the requirements of the law, the firm provides by a maintenance fund to which it contributes annually a fixed amount.

The following articles are exhibited:

Oxalic acid, Binoxalate of potassium crystals, — powder, Neutral oxalate of potassium, Oxalate of ammonium, Siccative, Oxide of chromium, Fluoride of chromium (D. R.-P. 44493 U. St. A. P. 421847), Sulphate of chromium, Acetate of chromium, Antimony salt 47%, — crystals 54% (D. R.-P. 57615 U. St. A. P. 479925), Fluoride of antimony and sodium 66%, Oxalate of antimony, Hydro-fluoric-acid, Fluoric-acid for spirit distilleries, — for glass etching, Fluoride of sodium, — of ammonium.

The products of the firm were rewarded at the following exhibitions:

Wiesbaden 1863, Stettin 1865, Paris 1867 (silver medal), Vienna 1873 (medal of merit), Philadelphia 1876, Düsseldorf 1880 and Antwerp 1885 (silver medal).

19. Kölling & Schmitt, Zerbst, Anhalt.

Proprietor: Fr. Kölling jun.

This factory is exclusively engaged in preparing from vegetable drugs, spices, ethereal oils and other raw-materials, compound essences for the manufacture of liqueurs.

Principal specialties of the firm, which are also exhibited:

Cognac-essence fine Champagne with bouquet, Jamaica-Rhum basis, Arac-essence, Rhum-essences, Kingston und Jamaica, Northausen "Korn-basis", Angostura-bitters-essence by Dr. Siegert, Aromatic-essence to Lappe, Benedictine-essence, Booncamp-essence according to Underberg-Albrecht, Chartreuse-essence, Tuttey-essence, lemonade extracts, taragon-essence, kümmel-oil.

20. Eugen Lahr, Manufacture of Gelatine-Capsules, Eschau, Bavaria.

Proprietor: Eugen Lahr, apothecary.

In this factory are produced among other things: gelatine-capsules, hard or elastic, filled with medicines of unpleasant taste; also gelatine-pearls, mercury ointments in elastic and graduated gelatine tubes, and bouillon-capsules. The production of the latter is patented in nearly all states; one of these capsules will be sufficient to produce a cup of beef-tea.

The exhibits embrace the whole of the above-named articles.

21. E. Merck, Darmstadt.

Proprietors: Wilhelm Merck, I. H. E. Merck, Dr. Louis Merck, Dr. A. E. Merck, Carl Merck and Dr. Willy Merck, Darmstadt.

This is one of the oldest and most important works which have devoted themselves to the manufacture of pharmaceutical and chemical preparations. — It has gradually developed out of the apothecary's shop which, since the year 1668, has been in the uninterrupted possession of the Merck family and is still connected with the factory. In 1817 H. Emanuel Merck started the manufacture of pharmaceutical preparations on a large scale. Already at this period began, with the preparation of morphia, followed a little later by santonine, nicotine and strychnine, the separation of the active principles of medicinal plants, the production of which, in the highest state of purity, has been the foundation of the reputation of the firm, and to this day remains one of its favourite specialties. In the thirties, codeine and narceine, in the forties, aconitine, coniine and atropine, and somewhat later digitaline and caffeine were, for the first time, manufactured in a pure state, and brought into commerce by the firm. Already in 1862 cocaine was prepared, but found no demand until about the middle of the eighties, when it met with general recognition.

In its present condition the factory is distinguished by the striking diversity of its productions. An extraordinary number of the various preparations for chemical, technical and pharmaceutical purposes is sent out from its workshops, and there is scarcely another factory in existence, which can boast of equal manysidedness. To the propagation of a knowledge of these products the firm contributes by the publications which it initiates. Among these must be mentioned: "Tests for the purity of chemical reagents," by Dr. E. Krauch (2nd edition, Berlin; publisher J. Springer) and a "Yearly Report" appearing regularly in the German, French and Russian languages, published by the firm in an edition of 10000 copies, and in part reproduced by an American trade-journal.

The firm has at all times kept up a lively correspondence with a large number of scientific men connected with their branch, and have received from them valued encouragement. With such men as Liebig, Wöhler, Wurtz and A. W. Hofmann the present proprietors have been on terms of close friendship.

A large number of the various preparations of the firm, especially the alcaloids, have been partly discovered in the factory, partly manufactured there for the first time. Many of them have been protected by patents which the firm possesses in Germany as well as in the United States.

The buildings of the factory, the offices, stores and cellars, occupy a total area of 50000 square meters; 450 workmen are engaged. The necessary steam is produced in 12 boilers of together 1000 square meters heating surface; 11 motors produce together 261 H.P. which drive a number of auxiliary machines. The factory is connected by its own rails with the railway, and possesses its own trucks for the carriage of sulphuric and hydrochloric acids. The raw materials worked up, like the final products, are extremely numerous and various. The exports of the firm extend to all countries of the old and new worlds.

Altogether, for the management of the works, about 100 employés are requisite, among whom 28 chemists.

The wages paid by the factory to its workpeople are 20 per cent. higher than the average wage obtainable in the neighbourhood. In addition to those required by law, the firm makes a number of provisions for the welfare of its workpeople. Among these are baths, dwellings, supplies of fuel at cost prices, the grant of advances without interest, the maintenance of women lying-in, and of persons

claimed by military conscription, and lastly the establishment of a working-man's pension fund.

Trade-Mark.



22. Gustav Rhodius, Burgbrohl.

Proprietors: Gustav Rhodius, Dr. Hans Andreae.

This factory, founded in 1867 on a small scale, has since then gradually expanded and has taken up, as a specialty, the refining of the products of the larger chemical industry and the production of pure salts, in accordance with the prescriptions of the pharmacopœia. In so doing, it avails itself largely of the perfectly pure natural carbonic acid gas, which pours out of boreings on the spot. As raw-materials of its manufacture, it employs the calcined soda of commerce (annual consumption 250 tons), calcined potash (200 tons) and crude magnesia (150 tons). From these are produced, by dissolving and treating with pure carbonic acid, potassium and sodium carbonates, chemically pure soda and potash, magnesium carbonate and calcined magnesia.

The factory occupies, under the superintendence of the owners, 38 workmen. A boiler of 20 HP. produces the necessary steam, and 2 steam-engines and one water-wheel drive the machinery.

The following articles are exhibited by the firm:

Kalium bicarbonic. cryst. pur., — purissimum, — carbon. pur., — purissimum, Natron carbon. puriss. sicc., — cryst., — bicarbon. puriss. pulv. (free from monocarbonate, chem. pure), Magnes. carbon. leviss., — usta levissima.

23. J. D. Riedel, Berlin and Grünau, near Berlin.

Proprietors: Paul Riedel and Fritz Riedel.

The factory was founded in 1812 by the grandfather of the present proprietors and has concerned itself exclusively, since its foundation, with the manufacture of chemico-pharmaceutical preparations. In 1826

J. D. Riedel undertook, on behalf of the Prussian government, the manufacture of quinine from the then for the first time imported cinchona bark. In the year 1842, the son of the founder, apothecary Gustav Riedel, took over the business which then occupied 35 persons. Under his management the business grew to such an extent that a removal from the Friedrich-, to the Gerichtsstrasse, became necessary. In 1881 a new building was erected, and in 1888 a branch establishment was founded at Grünau, which since that time, has quadrupled its original extent.

At the present time the firm occupies 10 chemists, 150 employés (druggists, apothecaries, clerks and travellers) and 200 workmen. There are 5 steam-engines of together 400 HP. and 5 motors in activity. The products manufactured out of the most varied raw-materials are chemico-pharmaceutical preparations, technical and medicinal drugs in every possible commercial form, which find a market partly at home and partly abroad. As a leading article, for example, Riedel's Insect powder is sent to all parts of the world. For 60 years the firm has made uninterrupted deliveries to the army.

As specialties the firm has recently taken up the preparation and introduction of new synthetical preparations for medicinal use. Among these the following were either discovered in the factory, or for the first time prepared on a large scale, and introduced into commerce: iodophenin, thiol, salipyrin, saliphene, tolypyrin and tolysal, dulcine, quinine (1826) methylene chloride, bromethyl, sulphonal, phenacetine, tannal, salumine, phenosol.

The new products introduced by the firm are under the protection of numerous German and foreign patents. The firm has won many awards at exhibitions, among others, at the Berlin Industrial Exhibition 1879 the State-medal, in Brussels 1888 two gold medals, and at the United Medical Congress in Lemberg 1888 a diploma of honour.

To the Columbian Universal Exhibition the firm will contribute the following selection of exhibits:

Sulphonal — crystallized and pulverized phenacetine — crystallized and pulverized patent thiol (D. R. P. and U. S. P. discoverer Dr. Jacobsen) — Guaiacol and derivatives, salipyrine, tolypyrine, tolysal, new antipyretic and antineuralgic remedies, patented; oil of wintergreen, diphenetolguanidine and salts; iodophenine, patented (discoverer Dr. L. Scholvien). Dulcine, (p-phenetolcarbamide) a new sugar-substitute of great power; chloralhydrate crystallized and in tablets; dialysed tannin patented, gallic acid, ether bromatus, methylene chloride, me-

thylal, chloralchloroform, amylsulphonal, eucalyptus oil, amylacetate, p-ethoxyantipyrine-salicylate, caffeine, salumine, and many scientific preparations, mostly preparatory and by-products of the phenacetine and dulcine manufactures.

24. Dr. Schäffer, chemical factory, Charlottenburg.

Proprietor: Dr. L. Schäfer.

The business of this factory consists in the working up of the gas-liquors of the Charlottenburg, and a part of the gas-liquors of the Berlin, Gas-works. The various ammoniacal preparations and, in recent times, the liquefied anhydrous ammonia so largely used in ice-making machines, are produced, also a few other chemicals such as phosphates and certain peroxides. The annual value of this production, effected by means of 25 workmen, amounts to 400 000 marks.

The exhibits are:

Anhydrous ammonia, salammoniac, crystallized and chemically pure, salammoniac in powder for electrical purposes, salammoniac in large crystals for electrical purposes, salammoniac in large crystals for galvanizing.

25. Dr. Theodor Schuchardt, Görlitz (Silesia).

Proprietor: Dr. Albert Weil.

This factory was founded, 1865, by the late Dr. Theodor Schuchardt in Muskau, on the premises of the unsuccessful "Prinzlich Niederländischen" Alum works, whose manager Dr. Schuchardt had been.

At first only one workman was employed, but soon the business was transferred to Görlitz where a small factory was erected. Here one chemist, two clerks, one apprentice and 5 workmen were employed. The numerous business relations, which Dr. Schuchardt, mainly during his many long journeys, had created, soon gained for the firm a world-wide reputation and a large extension of the business. Every year some addition to the factory was called for, the largest in the year 1876, and at the present time the factory occupies an area of 8000 sq. meters. In 1892 the founder of the business died and [it then passed by purchase into the hands of the present proprietor Dr. A. Weil, a son-in-law of the deceased. As a sleeping partner (Commanditaire) Dr. Max Schöller of Düren is interested in the business.

The factory now occupies a staff of 7 chemists, 17 employés, and 50—60 workmen. As specialties, it produces from the most varied raw-materials preparations for scientific, medicinal and photographic purposes, as well as chemical reagents guaranteed pure. It

manufactures, in addition, metallic oxides and all other chemicals for the ceramic and glass-industries, certain products for dyeing, pure caustic alkalis and lastly the so-called "plastilina", a plastic opaque mass, highly recommended to sculptors as a material for modelling.

A number of chemical preparations were for the first time sent into commerce by this firm, for example: the alkaline metals in crystalline form, the fluid alloys of potassium and sodium, strophantine and many rare alkaloids, benzonaphtol (a new remedy for intestinal complaints), various metallic oxides with exceptional colouring properties for glass-fluxes, the most varied collections for scientific teaching.

The firm has contributed to the majority of exhibitions and has earned the following distinctions:

Honourable mention, Stettin 1865, Prize-medal Berlin 1865. First prize-medal Dublin 1865. Honourable mention Paris 1867. Member of the jury, Wittenberg, 1869. Silver medal Altona 1869. Silver medal Cordoba (South America) 1871. Gold medal Moscow 1872. Progress medal Vienna 1873. Diploma Bremen 1874. Prize-medal Santiago de Chili 1875. Medal Philadelphia 1876. Silver-medal Liegnitz 1880. Gold prize-medal Melbourne 1880. Gold and silver prize-medals Amsterdam 1883. First class medal Penzance (Cornwall) 1884. Gold prize-medal Antwerp 1885. Gold prize-medal Görlitz 1885. Centennial International Exhibition Melbourne 1888/89: first order of merit, Special Mention. Photographic Jubilee Exhibition, Berlin 1889, Silver medal. Hamburg 1889: member of the jury. Great general horticultural exhibition, Berlin, 1890, gold medal. Trinidad 1890, first class medal. Jamaica 1891, first class medal.

Among the exhibits the following deserve mention:

A. Scientific preparations (organic, inorganic, alkaloids etc.) among which:

Naringine, hurine muscarine, colchicine, strophantine, kawaine, proteacine, skatol, cholesterine, spermine, purpurine puriss. subl., urea pura, phenacetine, gallium oxide, thorium chlorate, retene, chromium sesquichlorate, gold chlorate, subl. etc.'

B. Rarer metals (electrolytic, in powder, molten and crystallized). Lanthanum, didymium, calcium, barium, strontium, manganese. Also indium, gallium, germanium, erbium, thorium, titanium, iridium, silicon cryst., silicon-magnesium, boron, niobium, vanadium, tellurium, a chemical factory which, later, was united with the works of Count Douglas to form the well-known consolidated Westeregeln Alkali Works. Then came in 1868 the foundation of the branch establish-

selenium, zirconium etc. Potassium and sodium, metallic, crystallized, in closed tubes with hydrogen (distinct crystals).

C. Chemically pure reagents. Molybdenic acid, molybdates; ammonium nitrate, tungstic acid, potassium rhodanate, potassium oxalate, neutral etc.

D. Medicinal-pharmaceutical preparations: benzonaphtol, salicylamide, monobrominated camphor etc.

E. Metallic oxides (for the glass- and ceramic industries). Copper oxide, ferric oxide, chromium oxide, nickel oxide, uranium oxide etc.

F. Caustic alkalis. Potassium and sodium hydrate, in lumps and sticks purified, also alcohol-purified.

G. Collections for scientific teaching, among which a collection of alkaloids and glucosides, of 80 physiological preparations from the animal kingdom, of tar-colours, of artificial crystals, of models of crystals and cuttings of precious stones.

H. Plastilina (mass for modelling).

26. H. Thiemann jun., Chemical Works, Stolp (Pomerania).

Proprietor: H. Thiemann jun.

These works manufacture and exhibit: Chemicals for scientific, pharmaceutical and technical purposes, also amber, molten, and amber-preparations, among which succinic acid, succinic salts and ethers.

27. Vereinigte Fabriken (United Factories) Zimmer & Co., Francfort o/M.

A Company arising out of the fusion of the firms Fridr. Jobst, Stuttgart, and C. Zimmer, Francfort o/M. President: Dr. Julius von Jobst. Managers: Dr. A. Weller, Dr. O. Hesse.

This company, at the present time one of the most important producers of quinine and other alkaloids in Germany, can boast, as regards its development, of a history reaching back a considerable number of years. In 1806 the firm of Fridr. Jobst was founded in Stuttgart, and in 1828 started the production of quinine on a manufacturing scale. In 1837 the foundation of the other associated firm Conrad Zimmer in Francfort o/M. must be recorded, and in 1838 the firm Friedr. Jobst created a branch establishment in Coblenz, while, on the other hand, the firm of Zimmer in 1855 erected a factory of artificial manures and aniline-dyes at Mannheim. In 1864 a new factory was built by Fridr. Jobst at Feuerbach near Stuttgart, while in 1865 C. Zimmer founded at Bornecke near Stassfurt.

ment "di Fridr. Jobst" at Milan. In 1878 the firm of Zimmer found it necessary to create its own cinchona plantation "Agasarie" in Java. In 1879 the firm Fridr. Jobst followed suit by the creation of the cinchona-plantation "Daradjät," with the cooperation of Dutch firms and under the management of the director of government plantations, van Gorkom.

In its present form, the company occupies a staff of 4 superior employés, 5 chemists, 170 subordinate employés and workmen. It employs, as raw materials cinchona bark, coca leaves, crude cocaine prepared in South America, and many medicinal drugs which lend themselves to the extraction of the most various alkaloids. In the working out of suitable methods for the obtainment of these alkaloids, besides numerous investigators not belonging to the factory, the following gentlemen have especially distinguished themselves: Dr. von Jobst, Dr. O. Hesse, Dr. G. Kerner and Dr. A. Weller. The products at the present time offered by the firm are: Quinine and its salts, Jobst and Zimmer brand, the whole of the secondary alkaloids of the cinchona barks, quinidine (cinchonine), cinchonidine, quinoidine, cinchonine, quinium, quinine pillules, quinine-chocolate-tablets, quinine-wine, berberine, cocaine, cotoïne and paracotoïne, morphine, codeïne and other alkaloids, extracts and tinctures of every description. For the welfare of their workpeople, the firm have made a number of provisions, placing at their disposal dormitories and baths, and allotments for cultivation by their families.

At exhibitions, the firm has been awarded the following distinctions:

1828 medal to Fridr. Jobst, Stuttgart. 1830 silver medal to Fridr. Jobst, Stuttgart, both on the occasion of exhibitions in that town. 1844 medal to Fridr. Jobst, Stuttgart, at the exhibition of German Industrial products of Munich. 1851 medal to C. Zimmer, Francfort o/M. at the Universal Exhibition in London. 1851 medal to Friedr. Jobst at the Universal Exhibition in London. 1855 silver medal to Fridr. Jobst at the Paris Universal Exhibition. 1862 medal to C. Zimmer, Francfort o/M. at the Universal Exhibition in London. 1864 medal to C. Zimmer, Francfort o/M., at the Art and Industrial Exhibition of Francfort o/M. 1867 gold medal to Fridr. Jobst, Stuttgart, at the Universal Exhibition in Paris. 1873 award of diploma as member of the jury for group III as well as a share in the diploma of honour for group II to Fridr. Jobst, Stuttgart, at the Universal Exhibition, Vienna. 1873 medal for progress to C. Zimmer, Francfort o/M., at the Universal Exhibition, Vienna. 1873 cooperator's medal to Dr. O. Hesse, Feuer-

bach, at the Universal Exhibition, Vienna. 1876 grand medal to Fridr. Jobst, Stuttgart, at the Universal Exhibition, Philadelphia. 1877 "Jury" medal to Fridr. Jobst, Stuttgart, at the international Tentoonstelling van Tuinbouw, Amsterdam. 1877 award of the honorary Doctor's degree in natural science to Julius Jobst, Stuttgart, by the university of Tübingen. 1881 diploma of honour to Fridr. Jobst, Stuttgart, at the Württemberg agricultural exhibition in Stuttgart. 1881 gold medal for science and art to Dr. O. Hesse, Feuerbach. 1891 gold Hanbury medal on the occasion of the 50 years jubilee of the Pharmaceutic Society of Great Britain, to Dr. O. Hesse, Feuerbach.

Among the exhibits of the firm, the most important, technically and commercially, are the following:

Chinidin (Conchinin) sulfuricum; Chinin bisulfuricum, — ferrocintricum, — hydrobromicum, — hydrochloricum; — salicylicum; Chinin sulfuricum "Jobst" and "Zimmer", — valerianicum; Quininpearls; Cinchonidin sulfuricum; Cinchonin hydrochloricum, — sulfuricum; Cocain hydrochloricum "Zimmer", Cotoin "Jobst", Paracotoin „Jobst".

Arecolin. hydrobromicum; Benzoyl-Pseudotropein. nitricum; Chinin. glycyrrhizanicum, — hydrochloricum sesquihydratum, — lacticum crystallisatum, — metacresotinicum; Chinin.-Hydrochinon hydrochloricum neutrale, — -Hydrochinon sulfuricum acidum, — -Orcin sulfuricum neutrale, — -Phenol hydrochloricum acidum, — -Phenol hydrochloricum neutrale, — -Phenol sulfuricum acidum, — -Phenol sulfuricum neutrale, — -Pyrocatechin sulfuricum acidum, — -Resorcin hydrochloricum neutrale; Cinchol; Cinchonidin. semiphenylicum, — sesquiphenylicum; Cinchonidin.-Phenol hydrochloricum neutrale, — -Phenol sulfuricum neutrale; Cinnamylecocain. hydrochloricum, — purum; Cocain. hydrojodicum, — nitricum; Cuprein. sulfuricum, — -Pyrocatechin. sulfuricum acidum; Hydrochloreinchonin. bihydrochloricum, — bihydrojodicum, — purum; Hydroconchinin, Hydrocoton (Trimethylphloroglucin); α -Isocinchonin bihydrojodicum, β -Isocinchonin hydrochloricum; Palmityl- β -Amyrin (from Cocawax).

Trade-Mark.



28. A. Wassmuth & Co., Barmen (Society by Commandite).

Personally responsible partner: Alfred Wassmuth.

This factory was founded in 1887 for the working of a new anti-septic "natrium chloroborosum" discovered by the chemist Dr. C. Rüger and has gradually, but not without difficulty, created a good demand for its products both at home and abroad. It has in fact been successful in obtaining from distinguished specialists an acknowledgment of the efficiency and trustworthiness of these products. Among others the bacteriological investigations of Professors Fresenius (Wiesbaden) and Emmerich (Munich) have shown, that the natrium chloro-borosum, in the form of the synthetically prepared liquor natrii chloro-borosi 15%, possesses a higher disinfecting power than carbolic acid, creoline, lysol etc. without the slightest injurious effect on the constitution. These admirable properties make the preparation eminently suitable for internal use, more especially in inhalations. In consequence it has occurred to the owner of the factory to construct an apparatus for inhalation in company, by means of which an exceedingly minute pulverization, or reduction to spray, of liquids of all kinds is obtained. The apparatus has been patented in Germany, the United States and other countries, and has met with great success in many spas, as for example Ems, Reichenhall, Oeynhausen, Truskawiecs etc.

As by-products of the "natrium chloro-borosum" the factory produces a number of preservatives which, under the names of „Barmenite“, „Barmenite-Pöckel“, „Butyrine“, find constantly increasing recognition among consumers.

The firm has contributed to a number of exhibitions, and obtained for its products the following awards: Cologne 1889, Ghent 1889, Nice 1890, Tunis 1890, Paris 1889 (gold medal), Leipzig 1887, Düsseldorf 1887, Cammin 1889 (silver and bronze medals).

29. A. Wasmuth & Co., Ottensen near Hamburg.

Proprietor: August Wasmuth.

This firm occupies from 75 to 80 workpeople, mostly women, and manufactures pharmaceutical articles, also special articles for agriculturists to whom it supplies cattle washes, remedies against vermin of all kinds and similar products. It also undertakes the manufacture of medicine-chests, instrument-cases and collections of drugs for home consumption.

Special articles for the exhibition are: Creoline, Lysol, Wasmuth's

corn-plaster-rings in the watch (protected by law, German patent secured), Wasmuth's essence for washing cattle.



Trade-Mark.

30. Friedr. Witte, Rostock (Mecklenburg).

Proprietor: Dr. Friedrich Witte.

This chemical factory was founded in the year 1856, as an addition to the Hirsch-Apotheke (apothecary's shop at the sign of the stag) belonging to the proprietor in Rostock. The shop having been disposed of in 1862, the factory was re-erected on premises acquired for the purpose and has since been carried on independently. Its development was a very slow one, the means of the proprietor being small and the number of preparations very limited. In the beginning of the seventies, however, the firm succeeded in producing a very active form of pepsine, and a little later on it attracted the attention of specialists by the production on a large scale of a preparation of caffeine remarkable for its exquisite beauty, which also won general recognition at the Universal Exhibition in Vienna 1873. These two products made the firm widely known, so that the demand for its products, and with it, the size of the factory, rapidly increased. A further step in advance was made by the manufacture of a rennet-preparation in powder form of the greatest importance to dairies. Since 1888 the firm has also taken up the manufacture of scientific chemical preparations, which it carries on in a second factory erected at Bramow, near Rostock.

In the two factories, there are, at the present time, 45 men and 3 women employed. 4 chemists superintend the work. The necessary steam is supplied by 2 boilers of together 52 H.P., the motive power by 2 steam engines of 8 and 12 H.P. respectively. A wire-rope worked by steam, connects the river with the factory in Bramow. The raw materials worked up by the factory are drugs of the most

varied description, pigs and calves' stomachs (for pepsine) febrine and products of tar-distillation.

The products of the factory are also manifold: extracts, benzoic acid and benzoates, chrysarobine, ergotine, jalap and scammony resins, scale preparations, iron-peptone and peptone, rennet-powders 1:300000 croton oil, nutmeg oil, pancreatine, especially pure pepsinum sol. Witte, pure xylol and xyleneol, and other scientific preparations from the group of aromatic compounds. The value of the yearly output of all these products amounts to 500000 marks. A large proportion is exported. The American representatives of the firm are Lehn and Finck in New-York, also Röthlisberger and Gerber, the latter exclusively for the rennet preparations, also in New-York.

The firm grants to a portion of its workpeople a percentage on the profits of its specialties.

In distinctions the firm was awarded: in Vienna 1873 the medal for merit, in Melbourne and Schwerin 1882 medals, and in Rostock, 1892, the state prize for conspicuous achievement: the gold medal.

The exhibits are:

1. Chemical and pharmaceutical products, and among these the following pepsine preparations: pepsinium germanicum, — granulatum, — saccharatum, — purum in lam. 1:1000, 1:2000, 1:4000, 1:10000, — absolutum 1:30 000.
2. Scientific preparations; among them a series of xylol preparations, and as a separate exhibition from the domain of organic chemistry, a collection of 200 preparations belonging to the aromatic series.



III.

The industry of tar-products and artificial colouring matters.

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The tar obtained by the dry distillation of coal is certainly the most complicated mixture of heterogeneous compounds which is known to chemistry. Looked upon in the beginning as valueless, it has become, in the course of the last 40 years, an inexhaustible mine of scientific and industrial novelties. Its investigation and utilization have been of especial benefit to the dye-industry, which draws from it an overwhelming proportion of its raw materials. True, the artificial colouring matters form by no means an antithesis to those, formerly in exclusive use, which spring from the animal and vegetable kingdoms; they are, on the contrary, closely allied to them, and in some cases identical with them; in fact artificial dyes are producible from many of the products of animated nature. But in coal-tar we have materials which played their part in the production of the colour-glories of ages long passed away, and if we now seek them out and arrange them according to their uses, we find ourselves possessed of an incomparable store out of which we can build up, at will, a new world of colour, whereas the products of the animal and vegetable kingdoms are for the most part too complicated to lend themselves to any considerable number of applications.

The history of the dye-industry is made up of a series of triumphs, which, in the rapidity of their succession and the scope of their effects, are without a parallel in the history of human industrial activity. Its first successes were due to happy accident, but as every fresh achievement was critically sifted in the light of science, the new branch of manufacture rose quickly to a state of perfection, in which, systematically and in obedience to definite scientific rules, it continued to advance, conquering one sphere of application after another. No industry has to the same extent known how to turn to account the results of scientific research, and on the other hand, none have rendered such services to science, nor opened out to her such fields of research. In this domain, science and manufacture are bound together by the closest ties, one constantly supplementing the other.

As is well known, while the older tar-colours were for the most part discovered in France, the distillation of the tar, which supplies the necessary raw materials, was first carried out on a large scale in England. Very soon the colour industry established itself also in England, Germany and Switzerland, whereas the production and exploitation of the tar on a large scale made but slow progress in Germany and France, and in fact have only attained importance during the last decade. On the other hand, the first step in the direction of the deliberate technical synthesis of colouring matters was made in Germany, namely by the production of artificial alizarine. By means of this newly created industry, which soon attained extraordinary magnitude, the German colour industry gained its first start in advance of foreign countries. Soon followed the technical utilization of the phthaleïn group, the discovery of which was due to pure scientific research. The practical development of this department, it is true, was carried to completion in Switzerland. Of paramount importance, however, was the adoption of the azo-dyes, of which the technical synthesis was first accomplished in an English, and shortly afterwards in a French factory. Very soon the method established itself in all German works, and under the protection of the newly created German patent law, assumed colossal proportions. The number of valid patents

relative to this group of dyes amounts at the present time to many hundreds, the number of separate dyes thus protected to thousands, and new ones are constantly swelling the list. But while this most fruitful domain of the colour industry was unceasingly expanding, the others were by no means idle. The constitution of the older dyes, owing their existence to empirical methods, was at last elucidated by the labours of able investigators; and the outcome of these researches was a whole series of new synthetical methods for the production of colouring matters which, as regards beauty of shade, diversity of application, and in some cases cheapness of manufacture, were vastly superior to the old ones. For many of these dyes entirely new raw materials were requisite, involving the discovery of new methods of production; but in almost every case the possession of these new materials led to new applications of the same. And so the German dye-industry which now stood entirely on its own footing, grew to its present magnitude.

To understand the wonderfully rapid expansion of the dye-industry, it must be borne in mind that it is in reality but the ultimate expression of the vast revolution which, since the foundation of this youthful industry, has taken place over the whole field of the obtainment and working up of textile fibres. The manufacture of artificial dyes came into existence at the very moment when it had become indispensable, and it was by no means an accident that it first saw the light in the workshop of the dyer. The importation of exotic fibres which set in at that very period, the demand which their adoption created for a range of colours corresponding to the multiplicity of the substances employed, shewed the utter inadequacy of the old colour methods and materials. The industry of artificial dyes, which supplied this want, was received with open arms, and had no need, as is the case with new branches of industry, to seek for a market. But in proportion as the dyer was supplied with new dye-stuffs, so his demands for the same grew more pressing and his pretensions more exacting. To meet them has not always been an easy matter for the dye-industry. In again, as ever, aiming at the highest attainable, it ultimately exerted a reforming and ennobling influence on

the technique of dyeing and printing. For example the dyer had, for a time, been contented with brilliant dye-stuffs without insisting upon their fastness, but after he had been supplied, in alizarine, with the first very fast artificial dyestuff, his demands in this direction became imperious, and the dye-manufacturer, taking them into account, supplied him with a whole series of dyestuffs, similar to alizarine in the methods of application and in fastness, which fairly enabled him to produce all shades of colour. But now arose the possibility of dyeing wool also in these alizarine colours and in this way was found for them a much wider field of utility than was originally thought of. On the other hand, the wish of the cotton dyer to be supplied with methods equal in simplicity to those in use in silk and wool-dyeing, led to the introduction of the so-called *substantive* cotton dyes, which in turn, proved eminently suitable to the dyeing of mixed goods, and to the production on wool of fast shades for milling.

The German colour-industry perceived, at an early period, that its success was bound up with the progress of those industries which are the consumers of its products. Far from standing apart from them, it has voluntarily become their co-operator. All German dye-factories maintain, at considerable expense, elaborately fitted up experimental dye- and print-works, in which new methods are constantly worked out and old ones reviewed and not unfrequently greatly improved. The factories become in this way the advisers of their customers. As they have no interest in keeping successful methods secret, but on the contrary are concerned in their popularisation, they contribute not a little to the continuous progress of the textile industry.

There can be no doubt that in the cultivation of these relations between producer and consumer, in which German industry has unquestionably taken the lead, is to be sought one of those factors, which together with the adoption of exact working methods, founded on strict scientific knowledge, have most contributed to the enormous development of the German dye-industry.

It goes without saying that this extraordinary growth could

not take place without a reflex action upon the source of the raw-materials, the tar-industry. In the beginning of the eighties, a complete revolution in the gas-works both of England and Germany took place; the production of gas at a low temperature was abandoned and the work carried on at the highest possible temperatures with the aid of regenerators. The immediate consequences were a diminution in the production of gas-tar, and a lowering of the percentage of the benzene-hydrocarbons; and the rise in the price of benzol which followed for a time, became the occasion for a determined effort to save the by-products of the preparation of coke for metallurgical purposes. In Westphalia, as well as in the Silesian coalfields, large coke factories sprung up, which working according to the new system, were rewarded with marked success. [At the present time, Germany, it is true, is still not in a position to cover her enormous requirements in tar-products, but she is no longer, to the same extent, dependent on their importation from abroad. Great progress has also been made in the separation of the various constituents of tar. In general, it may be affirmed that, at the present day, the raw materials of the dye-industry come into use only in a state of complete chemical purity. A number of the tar constituents, at one time absolutely worthless, such as pyridine, the creosote oils, carbazol and many others, have found new and useful applications.

Exhaustive statistics of the German tar-products and dye-industries are not obtainable; a series of numerical data on the dye-industry are however at our disposal, shewing its very rapid growth and present importance. We borrow them in part from the already quoted work of Wichelhaus.

As regards the consumption by the dye-industry of its principal raw-materials, the constantly increasing imports of the same may serve as a criterion of their amount. In the year 1880, therefore in one of the last years previous to the successful obtainment of the by-products from the coke-ovens, and at a time when Germany was still essentially dependent upon the importation of these raw-materials, these imports amounted

in Benzol and light tar-oils to . . 4250 tons
in naphtaline and anthracene to . 4108 „

In the year 1885, the new style of coke-ovens had started, but they were still unable to give much help to native industry, and the imports rose.

for benzol and light tar-oils to . 6732 tons
for naphtaline to 1765 „
for anthracene to 4247 „

The two last figures vouch for the extraordinary development of the manufacture of azo-dyes and alizarine.

Now it is a very striking and characteristic fact that in the following years, in which the new coke-ovens rapidly attained considerable importance, the increment in the import figures, nevertheless, goes on without abatement. The imports in the year 1890 were:

in benzol and light tar-oils . . . 7240 tons
in naphtaline 2516 „
in anthracene 5946 „

To correctly estimate the consumption of the dye-industry, we must add to these figures the home production which at the present time can scarcely be very much less than the imports. And further we must bear in mind that the colour industry requires large quantities, annually increasing, of other raw materials, and lastly that for the transformation of these raw materials into colouring matters, huge quantities of the products of the larger chemical industry and of finer chemicals are also consumed.

In an estimate which, in our opinion is too low, Wichelhaus expresses the production of dyes for a series of years in the following values:

1874 . .	24 million marks of which alizarin 12 million marks
1878 . .	40 „ „ „ „ 25 „ „
1882 . .	50 „ „ „ „ 35 „ „
1890 . .	65 „ „ „ „ 25 „ „

The greater part of this mighty production, which may be reckoned at $\frac{9}{10}$ of the total production of all countries put together, is exported to all parts of the world. In 1891 the German empire exported:

in aniline, azo- and resorcine dyes

8680 tons of the total values of 44 269 000 marks,
in alizarine 8168 tons " " 12 960 000 "

A very large proportion of these exports goes to eastern Asia, whose civilized peoples are more and more neglecting their native natural dyes in favour of the more brilliant, and in their application, more simple productions of European manufacture.

There are altogether some 20 factories belonging to the German dye-industry, which can almost all claim to be important. Only a few of the most prominent representatives of the industry have taken part in the collective Exhibition.



Exhibitors.

1. Actien-Gesellschaft für Anilinfabrikation, Berlin.

Directors: Dr. C. A. Martius, Albr. Schubart, Dr. L. Schad,
Dr. F. Oppenheim. Capital 3,5 million marks, Debentures
2,5 million marks.

This firm was called into existence, in the year 1872, by the union of the Gesellschaft für Anilinfabrikation, founded in 1867 by Dr. C. A. Martius and Dr. P. Mendelssohn-Bartholdy at Rummelsburg near Berlin, with colour-works long carried on at Treptow, near Berlin, by Dr. M. Jordan. [After the death of Dr. P. Mendelssohn-Bartholdy Drs. L. Schad and F. Oppenheim stepped into his place. The commercial management of the business is in the hands of A. Schubart.

Since the commencement of its existence, the factory at Treptow has enjoyed a special reputation for the excellence of its fuchsine, which, in contradistinction to all other German factories, it produced by the quicksilver process originally suggested by Gerbet-Keller, and brought into commerce under the name of rubine. This process still held its ground at a time, when all other German factories had adopted the arsenic-acid process of Medlock, and it was only after the nitrobenzol process, proposed by Coupier, and first carried out

in a German and then in an English factory, had been proved to be really practicable, that the firm introduced it into their workshops, working it out however in their own way and availing themselves of the experience acquired in the old process. To this day the product so prepared has retained in commerce the name of rubine.

Of special importance in the development of the company was the year 1878, in which it originated the manufacture of malachite-green, according to the process patented by Döbner. At the same time it acquired a licence, under the patent for the production of the Höchst scarlets, which it soon brought upon the market in excellent quality. Thus a beginning was made with the manufacture of azo-dyes, with which later on the firm was to achieve its greatest successes. With the production of the Höchst scarlets, the formation, by the so-called transposition process, of the higher homologues of aniline, discovered by C. A. Martius and investigated by him in collaboration with A. W. Hofmann, found its first technical application.

In the beginning of the eighties, the firm took up the manufacture of the very valuable crocein-dyes, in accordance with a process discovered in the factory, the validity of the patent to which it gave rise, having, however, to be defended by a tedious law-suit; in 1884 it acquired P. Bötticher's patent No. 28753, the importance of which for the development of the dye-industry it had, in contradistinction to the majority of the specialists of that day, correctly estimated. This is the well-known "Congo-red" patent, which headed a whole series of discoveries in the department of so-called substantive azo-colours, dyeing cotton without a mordant. By its agreement with the firm to be described below, Farbenfabriken, vorm. Fr. Bayer & Co., which had become possessed of similar discoveries, a further extraordinary development of the new method was brought about; on the other hand it may be affirmed that no new departure in the domain of artificial colouring matters has, in its turn, worked so complete a revolution in the technique of dyeing.

In the year 1886 the Actien-Gesellschaft became the possessor of the Farbenfabrik vormals Bronner & Co. in Francfort o. M., and in 1890 of the colour-works of Georg Carl Zimmer in Mannheim, acquiring at the same time many important patent-rights relating to the production of azo-dyes and methylene-blue. After the liquidation of these concerns, the manufacture of the dyes referred to was transferred to the factory at Treptow.

In addition to the achievements already mentioned, there are still a number of discoveries to be named which have proceeded from the

laboratories of the firm, have been patented and have turned out more or less successfully. These are Guinea-green, wool-black, chinoline yellow, chinoline red, flavazol, Emin-red; and from the group of substantive cotton dyes: brilliant Congo, brilliant purpurine, Congo-orange, Congo-Corinth, Congo-brown, Congo-rubin, Nyanza-black, Tabora-black, erica, Chicago-blue etc.

In recent years, the firm has endeavoured, with conspicuous success, to render new tar-preparations serviceable to photography.

The extent of the two factories, belonging to the firm at Rummelsburg and Treptow, has, since the foundation of the company, increased to four times their original size. At the present time 600 men and 90 women are employed, the latter in the packing rooms. There are in the two factories 24 boilers at work, which supply the necessary steam for 17 engines and for heating and boiling purposes. In the works at Rummelsburg is carried on independently the manufacture of the nitric acid necessary for the nitration of the benzol-hydrocarbons, and for the carriage of the large quantities of oil of vitriol employed, tank-boats are in use which avail themselves of the water-way of the Rummelsburg lake.

As raw-material the firm works up at its Rummelsburg factory the whole of the products of tar-distillation, out of which, in the first line, it prepares the finer raw-materials of colour-making; nitrobenzene, aniline and all its homologues, the alkylic bases of the benzene-series, naphтол, naphтол- and naphtylamine-sulphonates, benzidine and allied bases; these are then converted into finished dyes at Treptow.

The firm is also interested in a number of foreign factories which, wholly or in part, work for their account.

In the Berlin factories of the firm there are 30 chemists, 60 office-employés, and a considerable number of technical employés.

For their workpeople the firm provides in the manner prescribed by law, also by a number of arrangements for their comfort. In addition there are two relief-funds, receiving no contributions from the employés and workmen, but the interest from which is applied to the support of the workpeople in case of sickness and accident. The workpeople's relief-fund amounts at the present time to 130000 marks and the fund for the employés to 70000 marks.

At exhibitions the firm has received the following distinctions:

Vienna universal exhibition 1873 bronze medal (Rummelsburg factory). Philadelphia universal exhibition 1876 bronze medal. Berlin 1877, international exhibition of the leather industry gold medal. Berlin 1878, international paper-industry exhibition gold medal.

Leipzig 1880, German woollen industry silver medal. Berlin 1889, photographic jubilee exhibition silver medal. Palermo 1891, national exhibition gold medal.

The firm exhibits the most important of their colouring matters, the chief representatives of each group, and further has illustrated the multifarious application of the tar-colours by a rich collection of practical samples dyed with their products.

Trade-Mark.



2. Badische Anilin- und Soda-Fabrik, Ludwigshafen o./Rh. Actien-Gesellschaft (Limited company). Branch establishments at Neuville-sur-Saône, France, and Butirki near Moscow, Russia.

Directors: Dr. H. Brunck, Dr. C. Glaser, A. Hanser.

This firm owns unquestionably the largest chemical factory in the world. This is the well-known establishment at Ludwigshafen, which was founded in 1865, the firm having, a short time previously, come into existence by the fusion of several already important colour-works. On the then vacant ground called Hemshof, in front of the town of Ludwigshafen on the Rhine, the new factory was built, and in May of the year 1865 began work with a staff of 30 workmen. Of the rapid expansion of this admirably organized and conducted factory the most striking picture is afforded by the following table, shewing the number of workmen employed in each year since the foundation.

In may 1865	30 workmen	Beginning of 1874	722 workmen
Beginning of 1866	135	"	1875 835
" 1867	310	"	1876 940
" 1868	432	"	1877 1123
" 1869	470	"	1878 1244
" 1870	520	"	1879 1427
" 1871	470	"	1880 1534
" 1872	665	"	1881 1922
" 1873	615	"	1882 2110

Beginning of 1883	2378	workmen	Beginning of 1889	3401	workmen
"	1884	2423	"	1890	3596
"	1885	2330	"	1891	3756
"	1886	2320	"	1892	3765
"	1887	2628	"	1893	4000
"	1888	2993	"		

Since the commencement of its career the firm has made a point of producing in its own works the whole of the transitional and complete products of the tar-industry. Moreover with the view of securing its independence, it was the first colour-factory in Germany to take up the manufacture of the products of the larger chemical industry, all the acids and alkalis which it requires for its own consumption. It works up therefore, as raw materials, the products, enumerated below, of mining and tar-distillation, and produces from them by a multiplicity of reactions an extraordinary number of the most varied artificial dyestuffs.

The share-capital of the firm amounts to 16500000 marks. The works at Ludwigshafen cover altogether an area of 7785 ares, 2000 of which are covered by 323 factory buildings, 380 workmen's cottages and 75 employés' dwellings. The 4000 workers at the present time employed are all men; no women or children are employed. For the superintendence and management of the works, there is a staff of 2 managers, 78 chemists and 24 building and engineering specialists, while the office work, under one manager, is carried on by 180 commercial employés.

The factory is situated on the very bank of the navigable Rhine, and avails itself of this waterway for the carriage of a large proportion of its requirements, especially in coal (average yearly consumption 160000 tons) and Spanish pyrites. The ground on which the factory is built, is traversed by the road which leads from Ludwigshafen to Francfort. In addition the factory is connected by a double line of rails with the Palatinate railways. The interior traffic of the works is carried on by means of a network, ramifying in all directions, of normal gauge lines of a total length of 25 kilometers. 250 railway trucks serve for the carriage of goods inside the works. For the production of steam, there are 66 boilers of together 8200 HP. — 159 larger steam engines, of together 3500 HP., 3 gas engines of together 16 HP. and one electromotor of 2 HP. produce the necessary motive power and drive, among other things, 16 air compressors of together 650 HP., 10 vacuum pumps of together 70 HP., 4 machines for water supply of together 400 HP. and 3 dynamos of together

135 HP. The gas required for heating and lighting purposes is produced in a special gas-work, the yearly production of which is 8 millions of cubic meters. The water-consumption amounts to 9 million cubic meters annually.

As raw materials, the factory works up the whole of the products of tar-distillation, and in addition Spanish pyrites, nitrate of soda, limestone, rock and crystallized salt, peroxide of manganese, chromium salts, indigo, gallic acid and many other chemico-technical preparations. Its productions, as already stated, cover the whole field of artificial organic colouring matters, and in addition, refined indigo and indigo carmine from raw indigo, also the main products of the soda industry, the latter being principally made for its own consumption.

The factory can boast of pioneer-work in the introduction of a large number of the most important achievements of the tar-colour-industry. In the year 1868 it was the first to take up the synthetic production of alizarine, discovered by Graebe und Liebermann and patented in England and America. Shortly afterwards in collaboration with H. Caro, the only practical process for the manufacture of alizarine, anthrapurpurine and flavopurpurine from the sulphonates of anthraquinone was worked out. In 1874 the firm placed upon the market some new dyes which owing to their extraordinary beauty, at once attracted the liveliest attention, these were the resorcine-dyes, Eosine A, S and BN, that is to say: tetrabromfluoresceine, its ethylether and bromonitrofluoresceine. In 1875 alizarine orange and betanitroalizarine were made for the first time on a manufacturing scale, then followed in 1876 synthetical purpurine. In 1877 one of the most valuable colours was placed upon the market, namely methylene-blue discovered by Caro. In the same year followed the scarcely less valuable acid magenta and the allied acid violet. In 1878 a valuable colour was offered to the dyer in the form of fast-red. In the same year H. Brunck succeeded in transforming into a workable manufacturing process the reaction, observed by Prud'homme, which yields alizarine-blue. In 1879, a most important addition was made to the patents in the possession of the firm by the discovery of naphtol yellow S. In the same year, one of the first acid greens, Light-green, was also brought into commerce. The year 1880 is a memorable one to all who are versed in artificial colouring matters, for it was in that year that the long sought for synthesis of indigo was accomplished by A. Baeyer. The exploitation of this new conquest was undertaken by the Badische Anilin- und Soda-Fabrik, which brought into commerce, in the shape

of orthonitrophenylpropionic acid a substance suitable for the production of indigo upon textile fibres. Its use, however, owing to its high price, remained a limited one. On the other hand the method worked out by H. Brunck of solubilizing alizarine-blue, by treatment of the same with bisulphite, proved to be of the highest importance; the product of this reaction, alizarine-blue S, is the object since 1881 of a constantly increasing demand. In Blau-Schwarz (Blue-Black) B, the first of the now so numerous black azo-dyes was produced, 1882. In the years 1883—85, followed in rapid succession the new triphenylmethane colouring matters, the method of production founded on the use of phosgene having been worked out by A. Kern in collaboration with H. Caro. Of these the following have proved of lasting value: crystal-violet (1883) ethylviolet (1883) Victoria-blue B and 4 R (1883) night-blue (1884) auramine (1884) alkali-violet (1886). The acid violet 7B of C. L. Müller, the tetrazine discovered by J. H. Ziegler, and lastly alizarine-maroon were placed upon the market in 1885. In 1886 followed acetine-blue (C. Schraube) galloflavine (R. Bohn) anthracene-brown and naphthylene-red (A. Römer). In the year 1887 a new black azo-dye, Violetblack, was introduced, and in the almost forgotten naphthazarine of Roussin, was recognized a valuable dye which now comes into the market under the name of alizarine-black. Its combination with bisulphite prepared by Bohn has been introduced as alizarine, black S. Not less important was the discovery of the basic phtaleine dyes, of which the first was Rhodamine B. produced by Ceresole in the laboratory of the [Ludwigshafen works. Next came Rhodamine S discovered by Gnehm. In the same year was produced by Th. Reissig Nile-blue, remarkable for its beauty, and in addition the azo-carmine of C. Schraube, the cotton-yellow G of C. L. Müller, and lastly the carbazol-yellow, alizarine-green, alizarine-blue-green, and alizarine-indigoblue of R. Bohn, the alizarine-yellow A, discovered by R. Bohn, the alizarine-yellow C of M. von Nencki, and the salmon-red of C. L. Müller. In 1890 there came the azurine of R. Bohn, in 1891 the anthracene-blue of the same inventor, also the indone-blue of P. Julius, and lastly the acid violet 6BN of C. L. Müller.

It is clear from the preceding condensed statement, that the Badische Anilin- und Sodafabrik has played a very conspicuous part in the building up of the industry of artificial colouring matters. Nor must it be forgotten that many of its technical novelties have operated beneficially on the arts and on science far beyond the limits of the factory. It is impossible to develop this view in the space at our

disposal; we can only mention, as an example, that the manufacture of alizarine blue has become the starting point for the highly important researches on the chinoline derivatives. As has been stated for the entire industry of the tar-colours, so in this particular case, we find the closest intimacy between technique and science, the constant enrichment of the one by the conquests of the other.

That a firm, which employs 4000 workmen, the majority of whom are fathers of families, should consider it a duty to provide in the most generous manner and far beyond the prescriptions of the law, for the welfare of this large number of persons, is obvious. As a matter of fact, there are few factories which can boast of such extensive and comprehensive benevolent arrangements, as those which in the course of years have been created in connection with the works at Ludwigshafen. They may be summed up as follows:

A colony of 380 workmen's dwellings, which have been erected at a cost of $1\frac{1}{2}$ million marks, is adjacent to the factory. The occupiers pay a rent of 5—7 marks per month, an amount which barely covers the cost of maintenance. For the workmen living away from the factory, refreshment rooms with accommodation for 600 persons have been built at a cost of 80000 marks, and to this establishment a yearly contribution of 22000 marks is paid by the factory.

To the workmen's sick-fund as prescribed by law, the factory grants a voluntary subsidy, equal to 50%, to all sick workmen who have been engaged for more than 6 months. For the families of workmen living in Ludwigshafen, free medical attendance is provided, and for this purpose also a sanatorium with two medical assistants and two nurses is maintained at a capital expenditure of 35000 marks and a yearly subsidy of 12—13000 marks. In addition a workmen's hospital has been erected at a cost of 100000 marks. The town hospital, the church buildings, and other public establishments contributing to the welfare of the operatives, are financially supported by the firm.

The construction of a bath-establishment for women and children and of a school of domestic economy for the daughters of workmen, is at the present time being carried out.

Workmen who have been engaged in the factory for 5, 10, 15, 20, 25 years receive a seniority premium. Furthermore by a yearly deduction from the profits of the concern, a workmen's relief fund has been created, which amounts to about 660000 marks. This sum is invested in the firm, bearing an interest which helps to maintain workmen incapacitated from work, as well as the widows and orphans of workmen.

Lastly an employé's pension-fund has been created, to which the firm has presented a capital sum of 200000 marks, and contributes at the present time an amount which is double that of the contributions of the employé's.

There remains to be mentioned a foundation of the director, Dr. Brunck, who has erected in one of the healthiest spots in the Palatinate a convalescent home in which, from spring to autumn, workmen of the factory recovering from illness and requiring rest, find admittance.

The Badische Anilin- und Sodafabrik (or their predecessors) has won a number of distinctions at previous exhibitions. From the State of Württemberg it has received the great gold medal for art and science, and in addition the following exhibition medals: London 1851 (medal), Stuttgart 1852 (silver medal), Munich 1854 (great medal), Paris 1855 (silver medal 1. Class), London 1862 (medal), Paris 1867 (gold medal), Ulm 1871 (gold medal), Moscow 1872 (great gold medal), Sydney 1880 (first diploma), Melbourne 1881 (first diploma and gold medal), Amsterdam 1883 (diploma), Calcutta 1884 (gold medal), Antwerp 1885 (Diploma), London 1885 (gold medal), Melbourne 1888 (gold medal) and lastly the gold medal of the Society of Arts in London 1885.

List of exhibits: Aniline-, Resorcine-, Naphthol-, and Azodyes; Alizarine-, and Gallic acid-dyes; raw and auxiliary materials for the manufacture of these colors; dyed patterns shewing the application; of same on various materials.



3. Chemische Fabriken, vorm. J. W. Weiler & Co., Ehrenfeld near Cologne o. Rh., Limited Company.

Chairman: Dr. Julius Weiler.

This factory erected in 1861, and transformed in 1889 into a limited company with a capital of 2125000 marks, carries on the manufacture of aniline and allied products as raw-materials for colour-making, and is the oldest and most important of its kind. It possesses branch-establishments at Müngersdorf and Riehl. Starting from the products of tar-distillation, it produces the hydrocarbons of the benzene-series, their nitro-derivatives, also binitrobenzol and binitrotoluol; aniline, the toluidines, xylidines, naphthylamine and aniline salt, and delivers all these products in a state of perfect purity to the dye-industry. The firm produces the necessary nitric and sulphuric acids for its own

requirements, and is also a seller of the same. A portion of its production is exported to the United States.

This firm has been acknowledged at former exhibitions by the following rewards: Paris 1867 silver medal, Vienna 1873 medal of progress.

The following are the exhibits of the firm:

Benzene, Toluene, Xylene, Nitrobenzene, Nitrotoluene, Nitroxylene, Aniline, Toluidine, Orthotoluidine, Paratoluidine, Xylidine, Metaxylidine, Aniline salt, Xylidine salt, Nitronaphthalene, α -Naphthylamine, Naphthionate, Binitrobenzene, Binitrotoluene, Binitronaphthalene.

Trade-Mark.



4. Farbenfabriken, vorm. Friedr. Bayer & Co. in Elberfeld, Limited Company.

Managers: Friedr. Bayer, Henry T. Böttinger, Herm. König. Capital 9 million marks in shares, 3 million marks in debentures.

Head-establishment: Elberfeld. Branch establishments: Barmen, Moscow, Flers (France), Schelploh and Leverkusen o. Rh.

When, in the sixties, the dye-industry began to settle in Germany, a number of dye-works arose in Elberfeld and Barmen, among which the one founded by Fr. Bayer took the lead and gradually absorbed all the others, and in this way was established the present business, which may be reckoned among the most important of its kind. The Elberfeld factory now occupies 1600 workmen (among them 34 lads) and 300 employés. 70 chemists are busy with the superintendence of the factory, and with the execution of the necessary work of the laboratory and the dye-house.

In plant the firm possesses 64 boilers of together 5500 square meters heating surface, 73 steam engines of together 920 HP., 10 air-compressors, and numerous other machines for various purposes. The factory is connected with the railway, and possesses for the interior traffic a line of rails of normal gauge 1667 meters long. The consumption of fuel is 65000 tons per annum.

Of all the large German dye-works, this is the only one which manufactures but a small proportion of the necessary raw-materials.

Preferring to buy the latter, it devotes itself almost exclusively to the preparation of nearly every known dye stuff, the alizarine-dyes included, as well as, of late years, to the production of numerous pharmaceutical preparations. In respect of the latter, the firm is also included in group II.

The firm has distinguished itself by the large number of new products, which in the course of years, it has placed upon the market. These belong, in large proportion, to the groups of the alizarine and substantive azo-dyes, the latter having been introduced and developed in association with the Actien-Gesellschaft für Anilinfabrikation already mentioned under No. 1.

The following products were for the first time produced in the laboratories of the Farbenfabriken vorm. Friedr. Bayer & Co.:

A. Substantive azo-dyes for cotton: Benzopurpurine B, 4B, 6B, 10B (1885), deltapurpurine G, 5B, 7B, rosazurine B, G, diamine-red B, 3B (1886), congo-rubine (1891) geranine G, 2B (1892), benzo-orange R (1887), benzo-brown B, G, NB, GG, R extra, BX, NBX, BR, NBR, 5R, and benzo-dark-brown (1887—1892), diazo-brown G and V (1892), benzo-black-brown (1893); chrysamine G and R (1884), thiazo-yellow (1888), benzo-olive (1891), chloramine-yellow (1892), azo-violet (1886), heliotrope (1887), heliotrope 2B (1892), benzo-indigo-blue (1891), benzo-blue BX, 2B and 3B, benzo-pure-blue (1892), brilliant azurine 5G (1889), benzo-azurine 3G, G and R (1885) benzo-marineblue B (1892), sulphon-azurine (1889), brilliant sulphon-azurine R (1891), azo-blue (1885), diazo-blue-black (1892), benzo-black-blue R and G (1887), 5G (1892), diazurine G and B (1892) benzo-grey and benzo-black (1890), benzo-grey and benzo-black S extra (1891), diazo-black R, B and G (1893).

B. Other special dyes (in connection with alizarine-dyes):

1. Reds: Rhodamine S (1889), azo-fuchsine G and B (1889), azo-eosine (1886), azo-cochineal and azo-Bordeaux (1892), cloth-red G (1883) and B (1889), cloth-red 3B extra (1889), fast red BT (1878), chrome-red R (1892), carmoisine B (1885), orselline 2B (1883), Bordeaux BX and G (1879), Bordeaux extra (1884), chrome-Bordeaux (1892), 6R double (1892), croceïne scarlet of different shades and ponceau (1881), wool-ponceau 2R and R (1890), brilliant ponceau 4R (1882), scarlets and new-red of the croceïne series (1879—1880).
2. Oranges: diamond-orange (1891), cloth-orange (1887), chrome-orange (1892), croceïne-orange (1882).
3. Browns: cloth-brown (1887), azo-acid-brown (1892), diazo-chromine BS (1892), leather-brown 3 brands (1893) chrome-brown R (1892).

4. Yellows: diamond-yellow G and R (1889), diamond-flavine G (1891), chrome-yellow (1892).
5. Greens: fast green of various shades (1885—1889), azo-green (1889), diamond-green (1889), chrome-green (1892),
6. Violets: azo-acid violet 4R (1891), acid violet, fast acid violet 10B (1891), chrome-violet (1891), fast violet (1892).
7. Blues: sulphon-cyanine G and 3R (1892), chrome-prune (1892), chrome-blue (1891), azine-blue, new fast blue (1892), fast acid blue R (1893).
8. Greys and Blacks: diamond-black (1889), jet-black R and G (1888), Victoria black of various shades (1891—1892), new-grey (1889), indophenine (1889), and indophenine extra (1890), chrome-black (1892), celestine blue (1893).

C. Alizarine dyes: alizarine-Bordeaux B, G and 2G (1890), alizarine cyanine 3R and 2R, RG and G (1892), G extra (1892), anthracene yellow (1889), alizarine-cyanine-black G (1892).

D. Intermediate products: aniline-hydrofluoride (1892) and primuline-Bordeaux-developer (1892).

E. Pharmaceutical products: phenacetine, sulphonal (1884), trional and tetronal (1890), aristol (1890), europheue (1891), salophene (1891), losophane (1892).

Almost all the above-named products are protected by patents in all civilized countries. They are exported to all parts of the world and the firm, by the publication of suitable instructions for use, takes every care to make them widely known and to increase the demand for them.

The firm provides for the wellbeing of its workpeople by the usual arrangements prescribed by law, and in addition by gratuitous baths, eating-rooms and canteens.

Trade-Mark.



5. Rud. Rütgers, Chemical Works for tar-products, Berlin W. 35; Works at Schwientochlowitz (Upper Silesia) and Witkowitz (Moravia).

The office of the firm is in Berlin, from whence the works also are administered.

The factory at Schwientochlowitz was erected in the year 1888 for the working up of the coke-oven tars, the tar-oils and ammonia liquors of Upper Silesia. It handles yearly over 300000 double hundred-weights of tar, and is therefore the largest establishment of the kind on the continent.

In contradistinction to other tar-distilleries no half-products, but only products in a state of perfect purity, are manufactured. The exports to the United States are insignificant, only Carbolineum being sent there in any quantity.

The factory gives occupation to 5 chemists, one engineer and 18 commercial and technical employés.

The operative staff is composed of 220 men and 20 women. For the comfort of these the most ample provision is made by very cheap, healthy dwellings and dormitories: also eating rooms and canteens, where food and beer are supplied at cost price, but no spirits are allowed. Shower and tub baths are also at the disposal of the work-people, free of charge.

The factory at Witkowitz was erected last year and started work in the beginning of the present year. Up to the present time some 100000 double hundred-weights of coke-oven tar from the Ostrau coal-fields have been brought in, to be worked partly into finished products, partly, for the present, into half-products.

List of exhibits:

Crude tar, Ammoniacal liquor, Crude light naphtha, — second light naphtha, — heavy naphtha, — Anthracene oil, Pitch, Benzol 90%, — 50/90%, — pure boil. pt. 80,3° cent., Toluol pure boil. pt. 110,3° cent., Coal-tar benzene I, Solvent naphtha, Orthoxylol, Metaxylol, Paraxylol, Cumol, Coal-tar benzene II. Solvent-naphtha, Creosote oil, Sulphate of ammonia, Pyridine-bases for denaturing alcohol, Cresol, Cresylic acid 100%, Anthracene crude 50% pulverized, — — in crystals, — — pressed, Naphthaline crude, — pure sublimed, — — in crystals, — — pulverized, Phenylate of lime, Creoline, Roofing varnish, Refined tar for the lining of basic ovens, Varnish for iron

ware, Naphthaline in candles, Albocarbon, Crystal carboic acid cryst. 40⁰ cent. and 35⁰ cent., Sapocarbole, Carbolineum, α -Methylnaphthaline, β -Methylnaphthaline, Acridine hydrochlorate, Acridine, α -Pyrocresol, β -Pyrocresol, γ -Pyrocresol, Pyridine pure boil. pt. 116⁰ C. Chinoline, Acenaphthene, Phenanthrene, Anthracene pure pulverized and in crystals, Phenole absolute fused, melt. pt. 42⁰ cent., Phenole absolute in loose crystals, Naphthaline pure in crystals, Anthracene in crystals.



IV.

Industry of lakes and pigments, varnishes artists' colours, printers' colours and inks.



This industry, which is well-nigh as old as the art of painting, also established itself at an early period in Germany. The occurrence of suitable materials gave rise, here and there, to small factories in which these materials were prepared for subsequent use by powdering, grinding, elutriating and rubbing. That some of these products acquired a reputation extending far beyond the frontiers of Germany, is amply proved by the fact that their very names have established themselves in foreign countries as, for example, Cassel-brown, Francfort-black etc.

A notable increase in the demand for pigment colours was occasioned by the steady development of the book-trade. A perusal of old printed books is sufficient to demonstrate the excellence, even at the present day, of the colours prepared for that object. And in the same way, the works of a Holbein and a Dürer are a splendid testimony to the care with which, already hundreds of years ago, pigments and varnishes were prepared in Germany.

The newly founded science of chemistry won its first successes in this department. The discovery of Berlin-blue, that of ultramarine, of Schweinfurt green, are technical achievements of the infancy of chemical research, but which still bear valuable fruit.

The art of preparing lakes from organic colouring matters, which also dates several centuries back, owed an unexpected expansion to the introduction of artificial dyes, which were at once skilfully adapted to these purposes. To the old and tried wood-and madder-lakes, was added an endless series of new products, which, it is true, were not suited to all requirements, but were nevertheless extremely welcome, more especially as the growing use of paper, and the newly awakened taste for the coloured decoration of the most various objects, had enormously increased the demand for body-colours.

Hand-in-hand with these enhanced capabilities of the industry, a thorough investigation, (to which the first impulse was given by the art-loving king Ludwig I of Bavaria) of the technical methods of painting was going forwards. Long forgotten methods, as for example, encaustic and fresco-painting were, at his instigation, again cultivated, and brought nearer and nearer to a state of perfection. These endeavours have by no means come to an end, but have been persevered in up to the present time with growing zeal. Starting from the idea that the old masters were in possession of better methods of painting than those at our disposal, an effort is made to rediscover and revivify these methods, and although one may be permitted to doubt the correctness of the assumption, still the striving, to which it gives rise, for incessant improvement, is not without good results. In this department also great things are now being accomplished in Germany, and the products of German industry appertaining thereto enjoy the highest recognition and esteem both at home and abroad. Owing to the diversity of the businesses under consideration, and to the smallness of the peater number of them, as compared with the larger chemical industry, owing also to the extraordinary multiplicity of their productions, it is impossible to supply statistical data of this and the two following groups.



Exhibitors.

1. G. Bormann, Nachfolger, Berlin.

Proprietor: Max Otto.

This firm was called into existence in the year 1832 and enlarged 1844 by acquisition of the then well renowned works of J. Steiner. In the year 1869 Mr. M. Otto became proprietor of the firm, the reputation of which has still grown under his management and opened to its products the market of all parts of the world.

The firm employs 26 workpeople and prepares artists colours, printers inks, liquid colours, drawing papers, pencils and coloured chalks of every description.

2. Gademann & Co., Schweinfurt o./M.

Proprietors: C. F. Gademann, Alfred von Berg. —

Branch establishments at Schweinfurt and Niederwerrn near Schweinfurt.

This factory is the oldest mineral-pigment factory in Bavaria; it was founded as early as the year 1792, at first for the production of various brands of white-lead, to which later on were added chrome and lake-colours.

The factory occupies at the present time 100 workpeople, including 4 women, possesses 3 boilers of together 120 HP. and two watermotors.

The raw materials used are lead, zinc, zinc-salts, acids and salts of various kinds. From these the most varied pigments are prepared, among which the following deserve special mention: lithopon-white (zinc sulphide) which this factory is the only one in South Germany to produce, sulphate of baryta (blanc-fixe) white-lead of different qualities, chrome yellow, chrome green, Schweinfurt green, zinc green, various lakes, permanent Victoria-green as a non-poisonous substitute for Schweinfurt green, ceramic colours and adhesive gold.

Trade-Mark.



3. Dr. Graf & Co. in Berlin S., Brandenburgstrasse 23. Proprietor: Rudolf Lender.

General agents: 1. for the United States of North America and at the Universal Exhibition, Chicago, Bruno Grosche & Co., New York, 136 Liberty Street.

2. For England and the colonies: C. F. Otto Müller & Co. London E. C., 70 Gracechurch Street.

3. For Russia: Successors to A. Bergengrün, Riga.

This factory, founded in 1889, started simply with the manufacture of pharmaceutical articles, but very soon erected a special department for the production of technical preparations, among which Dr. Graf's patent "Schuppen Panzerfarbe" has rapidly acquired a world-wide reputation. It was discovered in the factory, has received many awards, and has been introduced into the United States under the registered name of "S. P. F." metal paint or compound. The colouring product, absolutely free from dust particles, consists of extremely thin, greyish-black, flexible scales with metallic lustre, which can only be triturated with difficulty and are refractory to red heat and to chemical action generally. These, in order to produce the paint, are stirred into a tough and very resistant varnish until a thick paste is obtained, which forms an excellent material for coating metallic objects of all kinds, especially constructions in iron, and not only fulfils all technical requirements as a priming and coating material, but is also remarkably cheap. Parts in iron, which are coated with the S. P. F. paint require no priming with linseed oil varnish or red lead, it is in fact preferable to omit the latter, and to give the iron a coat of the S. P. F. before putting the pieces together, as the coat is not injured by subsequent bending. — Among the pharmaceutical preparations discovered and produced in the factory, Dr. Graf's boroglycerine-lanoline has won universal recognition. It is known here under the shorter name of Dr. Graf's boroglycerine and has been introduced into England and her colonies under the registered name of "Byroline". It is a most efficient preparation when used on parts of the body suffering from the effects of perspiration, and therefore indispensable in those cases of painfully itching „rash" so common in tropical countries.

At the international exhibition, which took place in Leipzig 1892 for the red cross, the firm has been rewarded for its boroglycerine-products by the diploma of the city of Leipzig and the gold medal.

List of exhibits: Dr. Graf's Medicinal Wines, Pepsin-Rhubarb-Wine, Dr. Graf's Pills sugar-coated and not coated. Dr. Graf's

Areca-Tape-worm remedy. Quinine-Iron Pills, Catarrh-Pills, Rhubarb-Pills, Sagrada-Pills, Alkaline-Pastilles, Bronchial-Pastilles, Megrim Pastilles, China-Hair-wash, Helenin-mouth-water, Dr. Graf's Silvana, Asthma-Cigarettes.

Trade-Mark.



4. Hemelinger Chemische Industrie, Dr. Aug. Behrens & Co., Hemelingen.

Proprietors: Dr. Aug. Behrens, Wilhelm Büsing.

This factory, founded in 1881, is concerned with the production of rosin and tar-products, lubricating materials, coloured lakes, varnishes and soaps.

It employs 20 workmen, and its mechanical arrangements are very complete. Its raw materials are rosin, tar, fats, oils and dyes. From these it manufactures products of the annual value of 800000 marks, and among them the so-called enamel-lake-colours, and a varnish for artists are specialities discovered in the factory. The latter possesses a special process for the removal of acids from fats and oils.

5. Dr. Emil Jacobsen, Berlin. Laboratory and manufactory of chemico-technical specialties, founded 1864.

This well-known inventor in the most varied departments of chemistry exhibits as a novelty in the Collective Exhibiton his (legally protected) preparation Aquoline, which is destined to find extensive employment among artists. It is a new medium, to be added to tempera, guache and water-colours, to which it imparts increased adaptibility, durability and brilliancy. By the simultaneous use of "aquoline-fixative" peculiar effects are obtained and pictures produced which possess the qualities, without the defects, of tempera and oil-paintings.

An exhibited head by H. I. Louis (Berlin) and a full-length portrait by Müller-Breslau (Dresden) shew the peculiarities of Aquoline; tinted plaster figures by H. Finzelberg (Berlin) and other examples demonstrate its manysided applicability to the industrial arts. Other exhibits are: the caseine-varnish which obtained in Berlin 1879, the State-medal (employed in the interior decoration, among other places, of several Berlin churches and in the pictures of the cupola of the

Exhibition Palace and the Hall of Fame in Berlin), water-colours in cells and tubes, cerotine (a polishing material for photography and so-called "poker-work") indelible marking-inks in red and black, enamel-colours for the colouring of artificial masses, tooth-cement (according to an improved Rostaing's method), and thiol, the active principle of ichthyol (German Imperial patent and U. St. P). This manufacturer received distinctions at the exhibitions of Stettin 1865, Berlin 1865, 1878, 1879, Paris 1867, Cassel 1870, Moscow 1872.

Trade-Mark.



6. Kast and Ehinger, Stuttgart.

Works at Feuerbach, near Stuttgart.

The factory was founded in 1865 and produces book-printing and lithographic colours of all kinds, and in all shades, linseed-oil varnishes and masses for cylinder-printing. Its staff consists of 3 chemists, 17 employés and 50 workmen. A large proportion of the output is exported. The agent for the United States is Chas. Helmuth, 379 Pearl St. New-York, the agent for Canada J. Dörken, 43 St. Sacrament St., Montreal. The firm received awards at the exhibitions of Amsterdam 1892 (gold medal), Melbourne 1889 (bronze medal), Antwerp 1885 (silver medal), Amsterdam 1883 (silver medal) Stuttgart 1881 (silver medal), Berlin 1878 (second diploma), Santiago 1875 (first diploma), Vienna 1873 (Diploma), Ulm 1871, (bronze medal).

Trade-Mark.



7. Bruno Lampel, Köln-Ehrenfeld.

Proprietors: Bruno Lampel and Oscar Opdenhoff.

This factory at first established, 1876, on a modest scale and in hired premises, rapidly attained its present magnitude. The present installation dates from the year 1890. Amply provided with suitable

machinery, it produces, with a staff of 45 workpeople, earth and mineral pigments, as well as chemical colours of every description, and exports a considerable portion of its produce.

List of exhibits:

Earth colours, oxydes of iron, chrome- and zinc-colours, vermilionette and blacks.

8. Michel and Morell, Eppstein in the Taunus and Höchst on Main.

Proprietors: Ferdinand Michel, Carl Michel.

This factory commenced business in 1840 and passed into the hands of the present firm in 1846. It produces with a staff of 40 workmen black pigments only, ivory and bone black, lamp black and pine-soot, and copper-plate-colours of a total value of 400000 marks per annum. A portion of the output is exported to North and South America.

9. Tintenfabrik J. Moritz & Co., Hangenbieten, Alsace.

Proprietors: J. Moritz, son, Jenny Moritz.

This factory was founded in 1891 and is concerned with the manufacture of inks. In particular it produces a so-called dry copying ink, which permits of the writing obtained with it being copied without the use of water or strong pressure, simply by passing the hand over the dry copying sheet. The production of this ink is the discovery of the proprietor Jacob Moritz, and was considerably improved by his late brother Carl Moritz.

Exhibits: Dry-copying ink (in bottles) red, green, violet and black; a large copying book, with samples of hand-pressed copies in the above colours; a few small pocket copying books (order books) with a minute bottle of ink, the whole packed in a case. For the small copying books, a sale-counter is provided in the Exhibition.

10. Johann Gottlieb Müller & Co., Stuttgart.

Proprietor: Gustav Müller.

This factory was erected in 1891 for the production of fine tempera-painters' colours, with the mediums and canvas appertaining thereto, for art and decorative painting, according to the methods of the old masters rediscovered by Baron Alfons von Pereira-Arnstein.

Starting from the fact that the masters of the best period of the Italian and German Renaissance, whose works have retained their fresh-

ness and brilliancy down to the present day, never made use of the now universally adopted oil-colours, but produced their works in tempera-colours, Baron Pereira has endeavoured, by a most careful study of the best sources, to revive the old lost recipes for the preparation of colours. These efforts have been crowned with success. German, Italian and French artists, and in particular Franz von Lenbach, whose ceiling-decorations of the German Art Exhibition at Chicago have been painted in Pereira's tempera colours, have declared that they consider the latter are of an excellent quality never before attained, that they expect from the adoption and practice of Pereira's system a marked progress in art, and that in fact Pereira's discovery has laid the foundation for new developments, inasmuch as, quite apart from the intellectual advantages which it possesses, the adoption of Pereira's tempera-method and colours will avoid those dangers of rapid deterioration, darkening and cracking, to which artistic creations, executed in oil, are now subject.

The tempera-colours, mediums, varnishes and prepared canvas for artistic painting, all prepared according to Baron Pereira's instructions, are the object of the manufacturing business of the above named firm.

Pereira's methods are protected by patent from unauthorized use.

The general representative of the association of the chemical factories of Germany, Herr Richard Fischer, is entrusted with the agency of the firm.

11. W. Rannefeld & Co., Blankenburg in the Harz.

Proprietors: W. Rannefeld and Theod. Schulz.

This factory was founded in 1869 under the style of Heinrichs and Rannefeld; in 1890 the name of the firm was altered. At the same time branch establishments were founded in Thale (Harz), Saalfeld, and since 1892 also in Bruchmühlen (Hanover). The firm produces earth- and mineral-colours of a total annual value of 500 000 marks, which are in part exported to the United States.

The principal products of the firm are colours: umber, Sienna, ochre, blacks, Venetian, Pompeian and English reds, olives and water-colours.

12. Dr. Eugen Schaal, Feuerbach near Stuttgart.

Proprietors: Commerzienrath Gustav Siegle and Dr. Eugen Schaal.

The factory, after long preliminary researches in the laboratory, was founded in the year 1885, and after the lapse of two years, con-

siderably enlarged. It works at the present time with a staff of 16 workmen, and produces goods of a total annual value of about 500000 marks. The objects of the business are the resinic esters, discovered by Dr. E. Schaal, asphalt products, siccatives, turpentine, ester varnishes of all kinds, and so-called antioxiide. A part of the output is exported.

The workmen in the factory earn from 3 to 4 marks for a ten hours day. The factory provides for them in the manner prescribed by law and in addition by supplementary payments, by the establishment of a savings' bank and sick-fund.

The exhibits are: Various esters in four casks and four dishes, an assortment of ester-lakes and enamel-colours made with ester-lakes; shields varnished with ester-lakes or painted with lake colours, earthenware plates japanned and bronzed with ester-lakes; the model of a house varnished with ester-lakes and lake-colours; the model of a bridge, the iron parts varnished with ester-lakes, and a ship's model also varnished with ester-lake.

13. G. Siegle & Co., Stuttgart.

Proprietors: Geh. Commerzienrath Gustav Siegle, Carl Ostertag, Theodor Sprösser.

The factory was founded in 1848 under the style of Heinrich Siegle; in 1873 it united itself to the Badische Anilin- und Soda-Fabrik, and was carried on as a branch of the same until 1889, when it again became independent under the style of G. Siegle & Co.

It now carries on, with 5 chemists, 26 employés and 140 workmen, the manufacture of colours of all kinds for artistic and house painting, book- and lithographic printing, and is in this department one of the most important. Its carmine, carmine-lake, madder-lakes, carmine-cinnabar, imitation vermilion, permanent green (an oxide of chromium prepared in a peculiar way) its non-poisonous colours for confectioners and toy-manufacturers, flower papers, colours for the manufacture of paper, coloured paper and printed carpets, Turkey red oil for the purposes of dyeing, finishing and printing stuffs, its ready-made colours for the latter industries, are universal favourites and are exported in considerable quantities to the United States. The agents of the firm are: Wm. Pickhardt and Kuttroff, Liberty Street 98, New-York. For their subordinates the firm provides an employés-pension-fund, a workman's savings bank and relief-fund, baths and refreshment-rooms, and lastly a number of suitably fitted-up dwellings.

The firm has received the following awards at Exhibitions: Würz-

burg 1890, Melbourne 1889, Antwerp 1885, Calcutta 1884, Amsterdam 1883, Melbourne 1881, Sydney 1880, Moscow 1872, Ulm 1871, Paris 1867, London 1862, Paris 1855, Munich 1854, Stuttgart 1852, London 1851.



14. Vereinigte Ultramarinfabriken, vorm. Leverkus, Zeltner und Consorten, Limited Company, Nürnberg.

Responsible board of directors: H. Dietz, general manager, E. Hohlweg, Dr. J. v. Hörmann, August Gruber, managers. Share-capital 5500000 marks.

Offices: Nürnberg. Works: Nürnberg, Leverkusen near Cologne, Linden, near Hanover, Oberndorf-Schweinfurt, Marienberg, Sophienau, Andernach, Oker, Montabaur.

Number of workmen 505, of workwomen 107.

25 boilers with together 130 sq. meters heating surface; 24 steam engines of together 1001 HP., 16 water-wheels of together 80 HP.

The artificial production of ultramarine, a pigment obtained for hundreds of years by powdering the natural lapis-lazuli, was a problem which deeply interested the chemists of the first quarter of this century, and was ultimately solved in different directions independently and almost simultaneously. The first to carry out practically the manufacture of ultramarine, was unquestionably the chemist of the Royal Saxon Porcelain manufactory at Meissen, F. A. Köttig (1828). On a much larger scale the manufacture of the new product, on the basis of communications made 1827 by Gmelin, was carried out 1834 by Leverkus, 1837 by J. Zeltner. In this way arose the German ultramarine industry, represented by numerous firms, which by a further strengthening of its chemical foundations, by the production of ultramarine of the most various colours and shades of colour, by the increase of its resistance to acids, achieved many notable triumphs, but ultimately through over-production and unmeasured competition, seemed to be threatened with destruction. To escape from this peril, the two above-named oldest and most important German firms united in the year 1890, to form a limited company, which in the same year was joined by the firms: The Hanoverian Ultramarine factory, formerly Aug. Egestorff, in Linden; the

Schweinfurt, formerly Heidelberg, ultramarine factory in Oberndorf; the Actien Gesellschaft Blaufarbenwerk Marienberg; the Actien Gesellschaft Sophienau, Eisfeld; Jordan and Hecht in Oker; Andernacher Ultramarinfabrik I. Nuppeney & Co., Andernach, and Gebr. Bahl in Montabaur. The production of the firms: Julius Curtius in Duisburg and Actiengesellschaft Georg Egestorff's Salzwerke in Linden near Hanover, was taken over for sale during 15 years and the remaining firms in Germany: Theunert & Gechter, Chemnitz; Ultramarinefabrik Wilh. Büchner Limited Pfungstadt; Horadam & Co., Düsseldorf; G. G. Stinnes, Ruhrort; Sam. Fr. Holzapfel, Grub near Cobourg, were compelled to close their works.

The German ultramarine factories thus associated produce from the well known raw materials, alumina, silica, soda, sodium sulphate, sulphur, rosin, and charcoal all the known sorts of ultramarine in blue, green, violet and red shades, in powder and in paste, for the most varied applications, ultramarine paste for laundry purposes, laundry-blue in balls, sticks, cubes and powder in the most varied qualities and packages, annual value 4—5 million marks. A large portion of this output is exported.

The products of the Vereinigten Ultramarinfabriken, vormals Leverkus, Zeltner und Consorten have carried off the first prizes at all the exhibitions to which they have contributed. At the Universal Exhibition of Chicago the firm is "hors concours".

The Exhibit consists of a blue grotto and rocky structure in front of which lies a sphinx, which is intended to symbolize the secret of the formation of ultramarine. The group of rocks is surmounted by an eagle which holds in its claws the arms of the United States of America and Germany.

An oil-painting placed outside the gallery containing the chemical industry of Germany, behind the blue grotto, represents the application of ultramarine to laundry-work.

The packing of this laundry blue, which the company has exported since 1840 to the United states of North America, is legally protected by the Superior Courts of justice.



V.

Industry of glue and gelatine and their by-products.

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The manufacture of glue for technical purposes is an old German industry. Already in olden times Cologne-glue was a coveted and highly esteemed article of commerce. About the middle of this century, the discovery, due to Liebig and other investigators, that glue was an integrant part of all flesh nourishment, was rapidly turned to account, and soon from France and England, there appeared in commerce colourless, odourless, tasteless varieties of glue, in convenient forms, under the name of gelatine for table purposes and as a substitute for the more expensive isinglass. Nor was it long before the industry established itself in Germany. Later researches proved the important fact, that glue is a mixture of various substances, differing not unessentially from each other in their properties, and therefore unequally suited to many purposes, according to the raw material used and to the method of preparation adopted. A regard for these results of experience resulted for the glue industry in increased versatility. Of especial importance was the further discovery that, by means of dilute acids, the phosphates may be extracted from bones, and the remaining cartilage boiled down to glue. In this way the manufacture of glue became connected with the production of phosphorus-com-

pounds and especially with the manurial superphosphates introduced by Lawes.

The manufacture of gelatine, which is mainly produced from the refuse of hides, entered upon a new career by the discovery of the extraordinarily important photographic properties of this substance. Its capacity, in admixture with chromates, and under the influence of light, to become completely insoluble (discovered by Mungo Ponton and first utilized by Poitevin) led to its application first in pigment-printing and later on in photo-engraving and in the most various photo-mechanical processes. But its field of application was still further enlarged by the observation of the English physician Maddox, that gelatine is by far the most suitable material for the preparation of durable dry plates for photographic negatives. And in fact the gelatino-bromide of silver dry-plate very soon drove out the old troublesome collodion-process and its convenience gave rise to a quite extraordinary popularisation of photography and in consequence to an undreamt of demand for gelatine, which was further increased when gelatine began, in the positive photographic process, to compete successfully with albumen. Simultaneously, however, there was an increased insistence, on the part of consumers, for a pure gelatine. For photographic purposes, the gelatine must possess not only perfect colourlessness and transparency, but also absolute freedom, from admixtures susceptible of reducing the salts of silver. In meeting these requirements, the German gelatine industry has been in the highest degree successful, and it therefore now commands the markets of the world and supplies nearly the whole of the home and foreign consumption.



Exhibitors.

1. Wilhelm Bang, vorm. Otto Lindenhauer, gelatine factory, Hanau.

Proprietor: Wilhelm Bang.

This factory, the first of its kind, was founded in the year 1840, and employs at the present time 60 workmen. It works up, as raw material, bones, residues of button-making and skins, and prepares therefrom crude gelatine of different qualities, and especially gelatine for photographic and medicinal purposes, brewers gelatine &c.

The factory was awarded prizes at the exhibitions of Munich 1854, Stettin 1865, Philadelphia 1876, Adelaide 1887, and Melbourne 1888.

2. Caesar and Ewald, Sobernheim (Rhenish Prussia).

Proprietors: Carl Ewald, Heinrich Caesar.

This factory was founded 1886, and rapidly attained considerable magnitude, a fact attributed by the proprietors to the quality of their goods, and more especially to their success in completely freeing them from fat and acids.

The firm produces exclusively, with a staff of about 100 workmen, pure fat- and acid-free hide-gelatine from the residues of tanneries, the heads and hoofs of the skins, which are brought into commerce separately under the name of Leimleder (gelatine-leather). The value of the production amounts to 500000 marks per annum; a part of the output is exported, in particular to the United States. The firm point out that it is of extreme difficulty to remove completely, as they do, the fat contained in the raw material. This gelatine, completely free from fat and acids, finds especial application in the manufacture of coloured and fancy paper.

3. Deutsche Gelatinefabriken. Hoechst o. M. and Schweinfurt. Limited Company.

Managers: Wilh. Daur, F. Drescher, Dr. O. Gürke.

This firm has grown out of the combination of the well-known firms of Heinrichs in Hoechst a. M. and Drescher in Schweinfurt, forming a limited company with a capital of 1 million marks. The firm of Heinrichs claims to have been the first to take in hand the production of perfectly pure gelatine, especially for the manufacture of photographic dry plates. The firm of Drescher had also acquired a considerable fame in the same specialty. Both brands are still pro-

duced by the Deutsche Gelatinfabriken Limited. Other specialties of the firm are: the finest white and red gelatine in sheets for cooking purposes, German brewers-isinglass, gelatine for fining wine, thick gelatine for confectionery, paper and the straw-hat manufacture. As raw material, fresh calves' heads are used, and the ends of bones removed by the saw. — The value of the yearly production is about 1 million marks. The product itself enjoys a world-wide reputation, and is preferred in all countries for the making of dry plates. The factory occupies 12 higher employés, one chemist and some 200 workmen.

4. Fischer & Schmitt. Hoechst o. M. near Frankfort.

Proprietor: Dr. E. A. Schmitt.

This factory founded in the year 1869 produces gelatine and size-gelatine (gelatine glue) and as specialties:

Photographic gelatine (emulsion-gelatine) for dry plates, photo-engraving &c.; cut star-gelatine for cooking purposes, size-gelatine for capsules, for stiffening straw-hats, for paper, confectionery &c., and further satine-white for paper makers.

The exhibits are: gelatine for photo-engraving, photographic emulsion gelatine for dry plates (also extra hard) various sorts of sheet-gelatine in red and white. Colle- or size-gelatine super extra, gelatine for fining, star-gelatine cut (white and red) for table purposes.

5. Heidelberger Gelatinefabrik, Stoess & Co., Ziegelhausen near Heidelberg.

Responsible partner: H. Stoess.

This factory was founded in 1888 by H. Stoess, formerly a partner in the gelatine works of F. Drescher & Co., in Schweinfurt. Its organisation, based upon the 20 years experience of the proprietor, is of the most perfect kind, it works in accordance with the newest and best processes and produces gelatine of every description, and more especially Stoess's emulsion and photo-engraving, table and clear gelatine. The firm has received awards at several exhibitions. Especial attention is directed to export business.

Trade-Mark.



6. L. Hertz & Fils, St. Avold, Lorraine, Society by "commandite".

Responsible partner: Gottlieb Hertz.

This factory founded in 1861, employs a working staff of 110 men and 20 women, and produces glue and gelatine in various qualities as well as highly concentrated, high-class manures of animal origin. A part of the output is exported to the United States.

The exhibits are: Gelatine, gelatine glue, glue, Ostécolle for wine- and beer- fining, ground glue and gelatine, cut-gelatine, and highly concentrated high-grade manures of animal origin.

7. Gebrüder Koepff, Göppingen, Württemberg.

Proprietors: Heinrich and Paul Koepff.

The factory founded in 1880, was in the following years repeatedly and largely increased. It occupies at the present time a working staff of 80 persons. After completion of arrangements now in progress, the firm will be in a position to produce as much as 6000 cwts of fine gelatine annually. From calves' heads and feet the finest white and red gelatine of every description for table and technical purposes is produced. Specialties of the firm are "Koepff's family gelatine" and emulsion gelatine for photographic dry plates and photo-engraving, which enjoy much favour.

Koepff

VI.

The industry of fats, oils, candles, soaps and cosmetics.

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The above-named industry is largely developed in Germany. But it works mainly for the home consumption, and the majority of its members have therefore no interest in contributing to transmarine exhibitions. A few branches however form an exception to the rule. They work for the markets of the world and are therefore prepared and in a position to take part in the friendly competition of nations. We need only mention here the old and important industry of Eau de Cologne. Further more, there have grown up during the last few years, in this department of chemical manufacture in Germany, new and quite special branches, for example, the manufacture of lanoline, which, as has been shewn in so many other cases, are the result of pure scientific investigation and promise for the future important and lucrative developments.

The transformations, which have taken place of late years in this department, are not unimportant, they have partly sprung from a closer scientific investigation of the matter in hand, and are also partly due to the fact that this industry has been carried along by the rapid and increasing developments of other branches of chemical manufacture. This is nowhere more manifest than in the department of perfumery, which, formerly limited to the exclusive use of the products of the

vegetable and animal Kingdom, has now to reckon, in the first line, with the synthetically produced perfumes which are being placed in a chemically pure form on the market. That in the employment of the latter many blunders and exaggerations were at first committed is natural enough; but on the whole it may safely be asserted that the store-house of the perfumer has been enriched by modern synthetical technique in a similar way to the palette of the colorist.



Exhibitors.

1. Johann Maria Farina, Jülichspatz No. 4, Cologne o./Rh.

This firm manufactures the real Eau de Cologne so well known and highly esteemed in the whole world. The sole representatives for the United States of America are: Park & Tilford, New York, 917 Broadway.

Trade-Mark guarded by law.



2. Benno Jaffé & Darmstaedter, Lanoline factory, Martinikenfelde, near Berlin.

Proprietors: Dr. Benno Jaffé and Ludwig Darmstaedter.

The fat contained in sheep's wool, well-known and recommended for many purposes since the oldest times, has in recent years, owing to the researches of sundry investigators, attracted increased interest. After it had been shewn that wool-fat was quite a special product of nature, and differentiated from all other fats by the fact that it contains, in combination with the fatty acids, not glycerine, but the two alcohols cholesterine and isocholesterine, the well-known professor

Liebreich, in Berlin, pointed out that fats of this kind are regularly found in the human skin and cutaneous structures. He therefore drew the conclusion that purified wool-fat, in a higher degree than other fats, was susceptible of resorption through the skin. He further discovered the remarkable property of purified wool-fat of mixing in all proportions with water and watery fluids, whereby a special homogeneous substance is produced, which is in fact lanoline. All these properties pointed strikingly to this body as a medium for ointments and as suitable also for many other purposes. After the production of lanoline had been patented (Germ. Imp. patent 22516, Amer. pat. 271192, 24 Jan. 1883) the above named works were founded at the end of 1885 for its manufacture. They prepare from the crude wool-fat of the wool scourers, the anhydrous wool-fat (*lanolinum anhydricum*) in a pure state, and place the same on the market partly as such, partly in the state of combination with water, lanoline properly so-called, and further in the form of cosmetic lanoline-preparations, such as lanoline-toilet-cream, lanoline-pomade and lanoline-soap.

Trade-mark for Germany, Denmark, Italy, Netherlands, Norway, Austria, Rumania, Russia, Switzerland, Spain, Hungary.



Trade-mark for America, Belgium, England, France.



3. L. Leichner, Berlin.

Proprietor: Johann Ludwig Leichner.

The above firm was founded by the present proprietor in the beginning of the seventies, and soon acquired considerable importance, the proprietor having succeeded in substituting for the plumbiferous face-powders, hitherto exclusively used by theatrical artists, preparations of equal freshness, but free from lead and therefore non-poisonous. The products of the firm were rewarded everywhere with the recognition and the popularity which they deserved, so that it now employs 65 workmen and women, and produces, especially for theatrical use, fatty rouge, fatty-powder, dry-cosmetics and powder-puffs of a total annual value of $1\frac{1}{2}$ million marks. The products of the firm

have gained the highest awards at many exhibitions in all parts of the world.



4. Anton Säuberlich, Zwickau, Saxony.

Proprietor: Anton Säuberlich.

This factory founded in 1859 produces cosmetic preparations, soaps, perfumery, artificial fruits etc. Its products have earned a high reputation and have received at various exhibitions high and, indeed, the highest distinctions.

5. Stettiner Kerzen- und Seifen-Fabrik. Limited Company.

Capital 450000 marks.

Manager: Josef Pfaff.

This undertaking originally founded in 1855 as a soapwork, has been since 1878 in the hands of the present company which, has largely extended it and brought it to its present state of prosperity. True, its efforts to open out markets in foreign countries were hampered by the duties imposed in 1879 which fell as a heavy burden on all the raw materials of the factory, so that it is only in a position to export certain specialties, namely coloured candles and christmas-tree-candles.

The factory occupies under the superintendence of 9 employés and 2 chemists, 200 workpeople of whom 130 are women. It possesses 4 boilers of together 100 H.P. and 4 engines of together 40 H.P. As raw materials it works up tallow, palm-oil, coconut-oil, linseed-oil, cotton-seed oil, as well as the usual chemicals for the saponification of fats and decomposition of soaps. It produces stearic acid and candles of the same, oleic acid, crude glycerine, and stearin pitch, potash and soda soaps, toilet soaps, soap for textiles, bleached palm oil, distilled fatty acids, soda crystals. The yearly value of this production amounts to $1\frac{1}{2}$ million marks. As already stated, the exports are limited to crude glycerine and coloured stearine candles. The latter were first introduced into commerce by the manager Josef Pfaff. The workpeople are employed as much as possible under agreement.

After a year of satisfactory service, they receive a premium of 5% on their total wage. In case of accidents in the works, the most indispensable medicines and competent aid are always at hand.

The exhibits are:

Coloured astral (spiral) crown candles, crown candles in the gothic and rococo styles, coloured decorated rococo (Loreley) candles, coloured astral-christmastree-candles, 12, 18, 30, 48, 60, 100 to the $\frac{1}{2}$ kilog., coloured smooth christmastree-candles, 12, 18, 24, 30, 40, 50 and 150 to the $\frac{1}{2}$ kilog.



VII.

Sundry articles required by chemical industry.

2

It is obvious that an industrial department as large and as manysided as the chemical industry, involves the cooperation of a number of trades, which without actually belonging to it, nevertheless supply it with a number of the most varied auxiliary requisites. There are many works in Germany, which are exclusively engaged in the production of the various kinds of apparatus employed in chemical manufacture, porcelain and glass factories, engineering shops, which produce the various instruments used in chemical laboratories, factories for casks, tins and card-board boxes for the packing of chemicals in large quantities, in a word a multitude of trades which produce all that is included in the above title.

In the collective exhibition of the german chemical industry a few manufacturers of these "sundries" have taken part, while others are represented in other sections. A large proportion however of these industries is unrepresented. It may, notwithstanding, be confidently asserted that this branch of german industrial activity has reached a high stage of perfection and that its products are appreciated and sought for all the world over. This is especially the case for those german glass- and porcelain-industries which work for the laboratories; their products being in requisition by chemists through-

out the world. The factories of this branch are indebted for their prosperity to a thoroughly competent and, for generations, highly trained body of workmen, as well as to a close observation of all the advances of science and manufacture.



Exhibitors.

1. **Deutsch-Oesterreichische Mannesmannröhren-Werke, Berlin.** Limited Company.

This company, which exploits Mannesmann's discovery of the rolling of seamless steel tubes, in their works at Remscheid (Rhenish Prussia), Bous near Saarbrücken, and Komatau (Bohemia), produces, for the holding of compressed gases, seamless steel cylinders in the manufacture of which the following points must be borne, in mind.

In the usual process steel-cylinders are made either from plates or from massive cylindrical blocks by pressure, the plate or block being, first at red-heat, worked into a cup-shaped cylinder, which is then, by a series of alternate pressing and drawing operations, transformed into a cylinder of ever increasing length and diminishing thickness. These operations are carried on in the cold, a method necessitating the adoption of a material sufficiently soft to withstand so thorough a change of form under the process of drawing.

By cold drawing and pressing the steel is profoundly modified as regards its physical properties, in this sense that the resistance to fracture and the limit of elasticity are considerably enhanced, whereas the ductility is largely diminished. The original tough material of relatively small cohesion is transformed into a brittle material of higher cohesion.

When a material of this kind comes to be heated to a high temperature, it returns to its original condition, that is to say the original lower cohesion and higher ductility are again obtained. But in these compressed cylinders the upper end must always be so heated, in order to forge or press it into the bottle-necked shape, so that in every cylinder of the kind the upper end is the weakest point.

In contradistinction to this method of manufacture, the Mannesmann process produces steel-tubes which are eminently suitable for

high pressure gas-holders and conduit-pipes. In the rolling of Mannesmann tubes, the material is neither worked in the cold, nor is it necessary to heat it to a very high temperature. During the whole process the temperature does not exceed red heat, which demonstrably can have no prejudicial effect upon the steel material employed. During the high pressure to which the latter is subjected in the rolling operations, a continuous condensation with simultaneous increase of ductility takes place, and as a result tubes made according to the Mannesmann process shew: 1. high cohesion; 2. a great difference between the limits of fracture and extensibility; 3. high ductility. These qualities are of the highest value, especially in all cases where there is a demand for high pressures followed by a removal of the same, as is the case with all vessels used in the carriage of compressed gas and with high pressure conduit-pipes.

In addition to these gas-receptacles, conduit pipes are also made of Mannesmann tubes; they may be had of all dimensions, at the present time up to 300 mm diameter, in lengths of 10 meters and more, all of one piece. Of these tubes large numbers are to be found in the German machinery building.

Common water-pipes, with flange connections, such as are customary in cast-iron pipes, also with screwed ends as in the case of wrought iron gas-pipes, also tubes with various forms of flanges and connections for high pressure purposes (up to several hundred atmospheres) can also be obtained from the Deutsch-Oesterreichischen Mannesmann-Röhren-Werken.

In the German machinery department such-like tubes and apparatus made therewith will be found, whereas in the group of chemical industry must be sought the carbonic acid and ammonia bottles, the tubes for their production, with trial tests of the same.

2. W. C. Heraeus, Hanau.

Proprietors: Dr. W. Heraeus, H. Heraeus.

Founded in 1851 by W. C. Heraeus, a short time after Deville and Debrais in Paris had shewn that considerable quantities of platinum may be melted by the oxy-hydrogen blow-pipe.

These researches laid the foundation of the separation and working up of platinum on a large scale, a method which up to the beginning of the eighties, was only carried out by three firms. One of these is the above-named, which in recent years has, by the introduction of sundry essential improvements, placed itself in a very advantageous position. Special mention must here be made of the pro-

duction in a state of purity of platinum, iridium and rhodium on a large scale, whereby it has become possible to produce rhodium and iridium wire, also alloys containing a high percentage of these metals with absolutely pure platinum, which find an application in the arts for pyrometric investigations. Further, by the introduction of the platinum-gold-combination in apparatus for the concentration of sulphuric acid, a substantial service has been rendered to sulphuric acid manufacturers. An apparatus, (Faure and Kessler's system) in platinum-gold may be seen at the Exhibition; also a sulphuric acid concentration-apparatus in platinum, (Delplace's system), lastly an exact model of a concentrating installation both according to Delplace and to Faure & Kessler.

Other exhibits are: platinum crucibles, dishes and other utensils for scientific and chemico-technical laboratories. Also foil and wire of pure platinum and platinum-iridium alloy. Here must be pointed out the fine wire of pure platinum, diameter 0,01 millimeters, also a large sheet of platinum foil, about 2000 square centimeters, thickness 0,01 mm.

To complete the exhibit, there is a collection of the salts of platinum and associated metals, which characterize the treatment, by the moist way, of the platinum ores. Among these we would mention those in greatest demand, namely: platinum chloride, platinum-potassium chloride, iridium oxide, iridium chloride, rhodium chloride, osmic acid.

3. Königlich Preussische Porzellanmanufactur, Berlin.

Proprietor: Royal Prussian Exchequer.

Factory at Charlottenburg, near Berlin.

In the year 1761, after the failure of the porcelain factory of Wegely, which had existed in Berlin since 1750, the merchant Gotzkowski founded another factory which, a few years later, was purchased by King Frederic the Great. The new factory soon attained great prosperity, which after the death of the king, lasted until the end of the century, but at the beginning of the present century a retrograde movement set in. In 1871 however the factory was transferred from Berlin to the Wegelystrasse in the Thiergarten, and in 1876 a chemico-technical experimental establishment for the entire department of ceramics was connected with it.

At the end of the seventies the factory made a new departure. New models, coloured glazes, new methods of decoration with enamel for hard porcelain were so many evidences of the progress achieved. A new porcelain, similar to the Japanese, and named after the inventor

Prof. Seeger, shewed a richer palette of coloured glazes and under-glaze colours, among which the colours produced by copper were especially noticeable for their beauty.

In more recent years the manufactory has successfully cultivated the painting of *pâte-sur-pâte* (in the working out of this process the chemist Dr. Pukall has rendered great service) and has also produced a new biscuit-porcelain similar to marble, resulting from the researches of the director Dr. Heinecke and his first assistant Dr. Hecht.

In addition to the artistic side, the factory devotes special care to the production of articles for chemical and technical use, and may fairly claim to be unequalled in the solution of the frequently very difficult problems submitted to it in this department. In particular it has earned a world-wide reputation for the material of which these objects are made, owing to its hardness and resistance to heat and acids.

In the production also of exceptionally large pieces, the manufactory accomplishes great things. For these purposes it avails itself of a process, involving air pressure, which has been worked out by the director Dr. Heinecke. The model-master Schley has also distinguished himself in the moulding of life-sized figures in one piece.

It must further be mentioned that the manufactory is indebted to the director Dr. Heinecke, for the preparation of new enamels on hard porcelain and to the artistic director Prof. Kips, for the introduction of weather-resisting plates of soft porcelain. Lastly it must be pointed out that the manufactory was the first to place upon the market the so-called "lithophanies", transparencies made of porcelain.

At the present time the factory is under the management of the chief director Dr. Albert Heinecke (chemist) and of the artistic director Prof. Alexander Kips (painter). It occupies 17 higher employés, among them 4 chemists and 480 workpeople including 8 women. It lies on the waterway of the Spree and the Landwehr-canal, but is not connected with the railway. It is lavishly supplied with mechanical means. For the driving of the mills and grinding machines it avails itself of the power supplied by an 80 horse steam-engine. It possesses numerous ovens, some of them of great size; of these a gas-oven with 22 chambers for continuous heating, and an oven with down-draft flame and mechanical stoking deserve especial mention. Its consumption of fuel is naturally very great. It is made up of 2000 cubic meters of wood, 3000 tons of German, 3200 hecto-

litres of English coal, 426 tons of brown-coal and 1600 hectol. of coke annually.

The raw materials worked up by the factory are the kaolin extracted from the wellknown fiscal mine at Halle, felspar, quartz and saggar-clay. From them are made by special treatment the various products of the factory: all kinds of ornamental and useful objects of hard and soft porcelain, utensils of hard porcelain for technical and chemical purposes, certain kinds of earthenware and chamotte-ware, of a total yearly value of one million marks. A large proportion of this output goes abroad, especially to the United States.

The Royal Prussian porcelain manufactory, in addition to its own development, aims at being a model establishment for the porcelain industry, so strongly represented in Prussia, and for this reason, it refrains from protecting by patent any of the novelties issuing from its workshops.

For the welfare of its workpeople the manufactory makes lavish provision. It possesses 52 workmens' dwellings, workmens' refreshment rooms and baths, a library, a workmens' relief and death-fund. Its subordinates receive at the expense of the State instruction in drawing in the establishment, or obtain admission into the educational establishment of the Royal art-industrial museum, or the Royal school of Art.

The Royal Prussian Porcelain manufactory has obtained prizes at all the exhibitions to which it has contributed.

4. Th. Müller, Schönebeck o. E.

Proprietor: Th. Müller, engineer.

This factory, founded in 1888, is engaged in the production of insulating materials from the pith of plants for the avoidance of losses of cold and heat and for the deadening of sound. It works up maize and durrah stalks and produces from their pith planks, segments and plates, also a mass for coating. The processes of manufacture are protected by patent.

The exhibits are:

Raw materials: maize stalks, also cut up, for the manufacture of blocks, planks and a mass for coating; dry insulating mass for spreading, examples of pith boards; pipe-covering in pith, carried out in various ways; models of insulation, pith blocks and boards for building purposes and for surrounding large objects; blocks of kieselguhr (fossil meal) for building purposes in the tropics.

5. Tritschler, Winterhalder & Co., Voithenberghütte, Station Furth a. Wald, Bavaria.

Proprietor: C. Hermann.

These glass works founded in 1842 employ 90 workmen and produce all sorts of hollow glass especially for chemical and physical purposes.

6. Georg Wenderoth, Cassel.

Proprietor: Georg Wenderoth.

This factory was founded in 1868 by the present proprietor and from small beginnings has attained considerable magnitude. It employs for its manufactures paper, pulp, wood, bone, vulcanite, celluloid, porcelain, glass and metal, and produces all sorts of card-board boxes, paper goods, printing, show glasses, sign boards, turnery ware for use in apothecaries' and druggists' shops and in chemical works. It employs altogether 450 workpeople, of whom 175 adult men, 225 women and 50 young people: there are 6 technical employés and a commercial staff of 45 clerks and 14 travellers.

Yearly turnover: 1350000 marks.

The factory is supplied with the electric light and is heated by steam. It is also fitted with an extraordinary number of various machines driven by a steam engine of 50 H.P.

The firm received prizes at the exhibition of Cassel 1870, Melbourne 1880 and Brussels 1888.

7. Otto Wenzel. Address-book of the chemical industry of the German Empire. 3rd year. 1892.

Publisher: Rudolf Mückenberger, Berlin.

The address-book and catalogue of wares of the chemical industry of the German Empire is edited by O. Wenzel, secretary general of the Association for the Protection of the Interests of German Chemical Industry. It contains a list of the firms belonging to the chemical industry with a statement of their products, directions as to the sources of supply of chemical products, raw materials and sundries, tables of customs' duties, and other legislative enactments affecting chemical industry, and especially all information calculated to facilitate intercourse between chemical factories among each other, and with their

customers. The address-book in its present third edition forms a strong volume; a fourth edition is in preparation for the year 1894.

This work which appeared for the first time in 1888 is widely known, not only in Germany, but in foreign countries also. Half of the issue is disposed of in Germany, Austria and Scandinavia, $\frac{1}{4}$ in England and the United States of America and the remainder in other parts of the world. For easier comprehension abroad, an English, French and Spanish translation is appended to the names of articles in the list of sources of supply.



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